Cambium PTP 600 Series User Guide

System Release 600-10-05

Cambium Networks

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Safety and regulatory information

This section describes important safety and regulatory guidelines that must be observed by personnel installing or operating PTP 600 equipment.

Important safety information

⚠ WARNING

To prevent loss of life or physical injury, observe the safety guidelines in this section.

Power lines

Exercise extreme care when working near power lines.

Working at heights

Exercise extreme care when working at heights.

Grounding and protective earth

The Outdoor Unit (ODU) must be properly grounded to protect against lightning. It is the user's responsibility to install the equipment in accordance with national regulations. In the USA, follow Section 810 of the *National Electric Code, ANSI/NFPA No.70-1984* (USA). In Canada, follow Section 54 of the *Canadian Electrical Code*. These codes describe correct installation procedures for grounding the outdoor unit, mast, lead-in wire and discharge unit, size of grounding conductors and connection requirements for grounding electrodes. Other regulations may apply in different countries and therefore it is recommended that installation of the outdoor unit be contracted to a professional installer.

PIDU

Always use the Cambium Power Indoor Unit Plus (PIDU Plus PTP 300/500/600 Series) to power the ODU. Failure to use the Cambium supplied PIDU could result in equipment damage and will invalidate the safety certification and may cause a safety hazard.

Alternative DC supplies

If an AC supply is not required or an additional back up DC supply is required, the DC supply is connected to the PIDU DC IN terminals. This is the only method of supplying external DC to the ODU. The DC supply must comply with the following requirements:

- The voltage and polarity is correct and is applied to the correct terminals in the PIDU.
- The power source is rated as Safety Extra Low Voltage (SELV).
- The power source is rated to supply at least 1A continuously.
- The power source cannot provide more than the Energy Hazard Limit as defined by IEC/EN/UL60950-1, Clause 2.5, Limited Power (The Energy Hazard Limit is 240VA).

Powering down before servicing

Always power down and unplug the equipment before servicing.

Lightning protection unit (LPU)

Do not remove the LPU printed circuit board when the LPU is connected to the power supply, as high voltages are present.

Drop cable tester

The drop cable tester must NEVER be used at the ODU end connected to power from the PIDU. It must only be used (with a multimeter) to test a cable with an ODU attached, not a cable with a PIDU attached. This is because the PIDU voltage exceeds the limit allowed in some countries for safe handling in wet conditions and therefore may create a safety hazard.

Primary disconnect device

The main power supply is the primary disconnect device.

External cables

Safety may be compromised if outdoor rated cables are not used for connections that will be exposed to the outdoor environment.

Grounding PTP-SYNC

In order to meet the safety requirements for deployment in Australia and New Zealand (AS/NZS 60950-1), the PTP-SYNC unit, if deployed, must be grounded to a Protective Ground in accordance with Local Electrical Regulations.

RF exposure near the antenna

Strong radio frequency (RF) fields will be present close to the antenna when the transmitter is on. Always turn off the power to the ODU before undertaking maintenance activities in front of the antenna.

Minimum separation distances

Install the ODUs so as to provide and maintain the minimum separation distances from all persons.

The minimum separation distances for each frequency variant are specified in Calculated distances and power compliance margins on page 4-54.

Important regulatory information

The PTP 600 product is certified as an unlicensed device in frequency bands where it is not allowed to cause interference to licensed services (called primary users of the bands).

Radar avoidance

In countries where radar systems are the primary band users, the regulators have mandated special requirements to protect these systems from interference caused by unlicensed devices. Unlicensed devices must detect and avoid co-channel operation with radar systems.

The PTP 600 provides detect and avoid functionality for countries and frequency bands requiring protection for radar systems.

Installers and users must meet all local regulatory requirements for radar detection. To meet these requirements, users must set the correct license key and region code during commissioning of the the PTP 600. If this is not done, installers and users may be liable to civil and criminal penalties.

Contact the Cambium helpdesk if more guidance is required.

USA and Canada specific information

The USA Federal Communications Commission (FCC) has asked manufacturers to implement special features to prevent interference to weather radar systems that operate in the band 5600 MHz to 5650 MHz. These features must be implemented in all products able to operate outdoors in the band 5470 MHz to 5725 MHz.

Manufacturers must ensure that such radio products cannot be configured to operate outside of FCC rules; specifically it must not be possible to disable or modify the radar protection functions that have been demonstrated to the FCC.

In order to comply with these FCC requirements, Cambium supplies variants of the PTP 600 for operation in the USA or Canada. These variants are only allowed to operate with license keys and region codes that comply with FCC/IC rules. In particular, operation of radio channels overlapping the band 5600-5650 MHz is not allowed and these channels are permanently barred.

In addition, other channels may also need to be barred when operating close to weather radar installations.

NOTE

To ensure compliance with FCC rules (KDB 443999: Interim Plans to Approve UNII Devices Operating in the 5470 - 5725 MHz Band with Radar Detection and DFS Capabilities), follow the instructions in Avoidance of weather radars (USA only) on page 2-5.

Other variants of the PTP 600 are available for use in the rest of the world, but these variants are not supplied to the USA or Canada except under strict controls, when they are needed for export and deployment outside the USA or Canada.

Specific expertise and training required for professional installers

To ensure that the PTP 600 is installed and configured in compliance with the requirements of Industry Canada and the FCC, installers must have the radio engineering skills and training described in this section. This is particularly important when installing and configuring a PTP 600 system for operation in the 5.4 GHz UNII band.

Avoidance of weather radars

The installer must be familiar with the requirements in FCC KDB 443999. Essentially, the installer must be able to:

- Access the FCC data base of weather radar location and channel frequencies.
- Use this information to correctly configure the product (using the GUI) to avoid operation on channels that should be barred according to the guidelines that are contained in the KDB and explained in detail in this user guide.

External antennas

When using a connectorized version of the product (as compared to the version with an integrated antenna), the conducted transmit power must be reduced to ensure the regulatory limit on transmitter EIRP is not exceeded. The installer must have an understanding of how to compute the effective antenna gain from the actual antenna gain and the feeder cable losses.

The range of permissible values for maximum antenna gain and feeder cable losses are included in the user guide together with a sample calculation. The product GUI automatically applies the correct conducted power limit to ensure that it is not possible for the installation to exceed the EIRP limit, when the appropriate values for antenna gain and feeder cable losses are entered into the GUI.

Ethernet networking skills

The installer must have the ability to configure IP addressing on a PC and to set up and control products using a web browser interface.

Lightning protection

To protect outdoor radio installations from the impact of lightning strikes, the installer must be familiar with the normal procedures for site selection, bonding and grounding. Installation guidelines for the PTP 600 can be found in Chapter 2: Planning considerations and Chapter 5: Installation.

Training

The installer needs to have basic competence in radio and IP network installation. The specific requirements applicable to the PTP 600 should be gained by reading Chapter 5: Installation and Chapter 6: Configuration and alignment and by performing sample set ups at base workshop before live deployments.

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About This User Guide

This guide describes the planning, installation and operation of the Cambium PTP 600 Series of point-to-point wireless Ethernet bridges. It is intended for use by the system designer, system installer and system administrator.

Users of this guide should have knowledge of the following areas:

- Radio network design
- Outdoor radio equipment installation
- System installation, configuration, monitoring and fault finding

System designers should refer to the following chapters:

- Chapter 1: Product description
- Chapter 2: Planning considerations
- Chapter 3: Legal information
- Chapter 4: Reference information

Installers should refer to the following chapters:

- Chapter 5: Installation
- Chapter 6: Configuration and alignment
- Chapter 8: Troubleshooting

Operators should refer to the following chapters:

- Chapter 1: Product description
- Chapter 6: Configuration and alignment
- Chapter 7: Operation
- Chapter 8: Troubleshooting

General information

Version information

The following shows the issue status of this document.

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Purpose

Cambium Networks Point-To-Point (PTP) documents are intended to instruct and assist personnel in the operation, installation and maintenance of the Cambium PTP equipment and ancillary devices. It is recommended that all personnel engaged in such activities be properly trained.

Cambium disclaims all liability whatsoever, implied or express, for any risk of damage, loss or reduction in system performance arising directly or indirectly out of the failure of the customer, or anyone acting on the customer's behalf, to abide by the instructions, system parameters, or recommendations made in this document.

Cross references

References to external publications are shown in italics. Other cross references, emphasized in blue text in electronic versions, are active links to the references.

This document is divided into numbered chapters that are divided into sections. Sections are not numbered, but are individually named at the top of each page, and are listed in the table of contents.

Feedback

We appreciate feedback from the users of our documents. This includes feedback on the structure, content, accuracy, or completeness of our documents. Send feedback to support@cambiumnetworks.com.

Problems and warranty

Reporting problems

If any problems are encountered when installing or operating this equipment, follow this procedure to investigate and report:

1. Search this document and the software release notes of supported releases.
2. Visit the support website.
3. Ask for assistance from the Cambium product supplier.
4. Gather information from affected units, such as any available diagnostic downloads.
5. Escalate the problem by emailing or telephoning support.

Repair and service

If unit failure is suspected, obtain details of the Return Material Authorization (RMA) process from the support website.

Warranty

Cambium's standard hardware warranty is for one (1) year from date of shipment from Cambium or a Cambium distributor. Cambium warrants that hardware will conform to the relevant published specifications and will be free from material defects in material and workmanship under normal use and service. Cambium shall within this time, at its own option, either repair or replace the defective product within thirty (30) days of receipt of the defective product. Repaired or replaced product will be subject to the original warranty period but not less than thirty (30) days.

To register PTP products or activate warranties, visit the support website.

For warranty assistance, contact the reseller or distributor.

⚠ CAUTION

Using non-Cambium parts for repair could damage the equipment or void warranty. Contact Cambium for service and repair instructions.

⚠ CAUTION

Portions of Cambium equipment may be damaged from exposure to electrostatic discharge. Use precautions to prevent damage.

Security advice

Cambium Networks systems and equipment provide security parameters that can be configured by the operator based on their particular operating environment. Cambium recommends setting and using these parameters following industry recognized security practices. Security aspects to be considered are protecting the confidentiality, integrity, and availability of information and assets. Assets include the ability to communicate, information about the nature of the communications, and information about the parties involved.

In certain instances Cambium makes specific recommendations regarding security practices, however the implementation of these recommendations and final responsibility for the security of the system lies with the operator of the system.

Warnings, cautions, and notes

The following describes how warnings and cautions are used in this document and in all documents of the Cambium Networks document set.

Warnings

Warnings precede instructions that contain potentially hazardous situations. Warnings are used to alert the reader to possible hazards that could cause loss of life or physical injury. A warning has the following format:

WARNING

Warning text and consequence for not following the instructions in the warning.

Cautions

Cautions precede instructions and are used when there is a possibility of damage to systems, software, or individual items of equipment within a system. However, this damage presents no danger to personnel. A caution has the following format:

CAUTION

Caution text and consequence for not following the instructions in the caution.

Notes

A note means that there is a possibility of an undesirable situation or provides additional information to help the reader understand a topic or concept. A note has the following format:

NOTE

Note text.

Caring for the environment

The following information describes national or regional requirements for the disposal of Cambium Networks supplied equipment and for the approved disposal of surplus packaging.

In EU countries

The following information is provided to enable regulatory compliance with the European Union (EU) directives identified and any amendments made to these directives when using Cambium equipment in EU countries.

Disposal of Cambium equipment

European Union (EU) Directive 2002/96/EC Waste Electrical and Electronic Equipment (WEEE)

Do not dispose of Cambium equipment in landfill sites. In the EU, Cambium in conjunction with a recycling partner ensures that equipment is collected and recycled according to the requirements of EU environmental law.

Disposal of surplus packaging

Do not dispose of surplus packaging in landfill sites. In the EU, it is the individual recipient's responsibility to ensure that packaging materials are collected and recycled according to the requirements of EU environmental law.

In non-EU countries

In non-EU countries, dispose of Cambium equipment and all surplus packaging in accordance with national and regional regulations.

Chapter 1: Product description

This chapter provides a high level description of the PTP 600 product. It describes in general terms the function of the product, the main product variants and typical deployment. It also describes the main hardware components.

The following topics are described in this chapter:

- Overview of the PTP 600 on page 1-2 introduces the key features, typical uses, product variants and components of the PTP 600.
- Outdoor unit (ODU) on page 1-7 describes the ODU and its interfaces.
- Powered indoor unit (PIDU) on page 1-12 describes the PIDU and its interfaces.
- Cabling and lightning protection on page 1-17 describes the cabling and lightning protection components of a PTP 600 installation.
- PTP-SYNC unit on page 1-22 describes the (optional) PTP-SYNC unit and its interfaces. This unit may be used to implement TDD synchronization.
- Wireless operation on page 1-25 describes how the PTP 600 wireless link is operated, including modulation modes, power control and security.
- Ethernet bridging on page 1-38 describes how the PTP 600 controls Ethernet data, in both the customer data and system management networks.
- Telecoms circuits on page 1-46 describes how telecoms traffic (E1 or T1) may be carried over PTP 600 links.
- System management on page 1-48 introduces the PTP 600 management system, including the web interface, installation, configuration, alerts and upgrades.
- FIPS 140-2 mode on page 1-60 describes the (optional) FIPS 140-2 a mode of operation.
- Unified Capabilities Approved Product (UC APL) mode on page 1-65 describes the (optional) UC APL mode of operation.

Overview of the PTP 600

This section introduces the key features, typical uses, product variants and components of the PTP 600.

Purpose

Cambium PTP 600 Series Bridge products are designed for Ethernet bridging over point-to-point microwave links in the licensed bands 2.5 GHz, 4.5 GHz, 4.8 GHz and 4.9 GHz, and in the unlicensed bands 5.4 GHz (ETSI Band B), 5.8 GHz (ETSI Band C and FCC ISM band) and 5.9 GHz. Users must ensure that the PTP 600 Series complies with local operating regulations.

The PTP 600 Series acts as a transparent bridge between two segments of the operator's network. In this sense, it can be treated as a virtual wired connection between two points. The PTP 600 Series forwards 802.3 Ethernet packets destined for the other part of the network and filters packets it does not need to forward. The system is transparent to higher-level protocols such as VLANs and Spanning Tree.

Key features

The key features of the PTP 600 Series include:

- True non-line-of-sight (NLOS) operation by using a combination of Orthogonal Frequency Division Multiplexing (OFDM) modulation and Multiple-Input Multiple-Output (MIMO) techniques.
- Wireless connections of up to 200km (124 miles) in near line-of-sight conditions and up to 10km (6 miles) in deep non-line-of-sight conditions.
- Coexistence with other users of the band using a combination of Automatic Transmit Power Control (ATPC), Spectrum Management functionality and Antenna beam shape.
- High link availability, through the use of adaptive modulation techniques that dynamically reduce the data throughput in severe or adverse conditions.
- High system gain through high sensitivity antennas for improved signal recovery.
- A radio system that operates on ultra-fast digital signal processors but is controlled by updateable firmware.
- A built-in web server for advanced management capabilities including detailed radio signal diagnosis.

- A comprehensive range of security features to prevent unauthorized access to data. Optional AES encryption for data transmitted over the wireless, with 128-bit or 256-bit encryption keys. Optional HTTPS/TLS security on the web-based management interface. SNMPv3 with optional AES privacy and SHA1 authentication. Remote authentication using RADIUS.

Benefit of the chosen bands

The PTP 600 operates in bands that offer the dual benefits of high data throughput and good radio propagation characteristics. The wide band of spectrum available is subdivided into several channels such that multiple systems can operate in the vicinity without causing interference to one another.

Similarity to 802.11a devices

The PTP 600 Series products are not 802.11a devices. Although similar, they use different encoding and radio transmission systems from 802.11a. In areas where 802.11a systems are operating, the products will detect the 802.11a radio signals and choose a clear channel away from any interference.

Avoiding interference from nearby devices

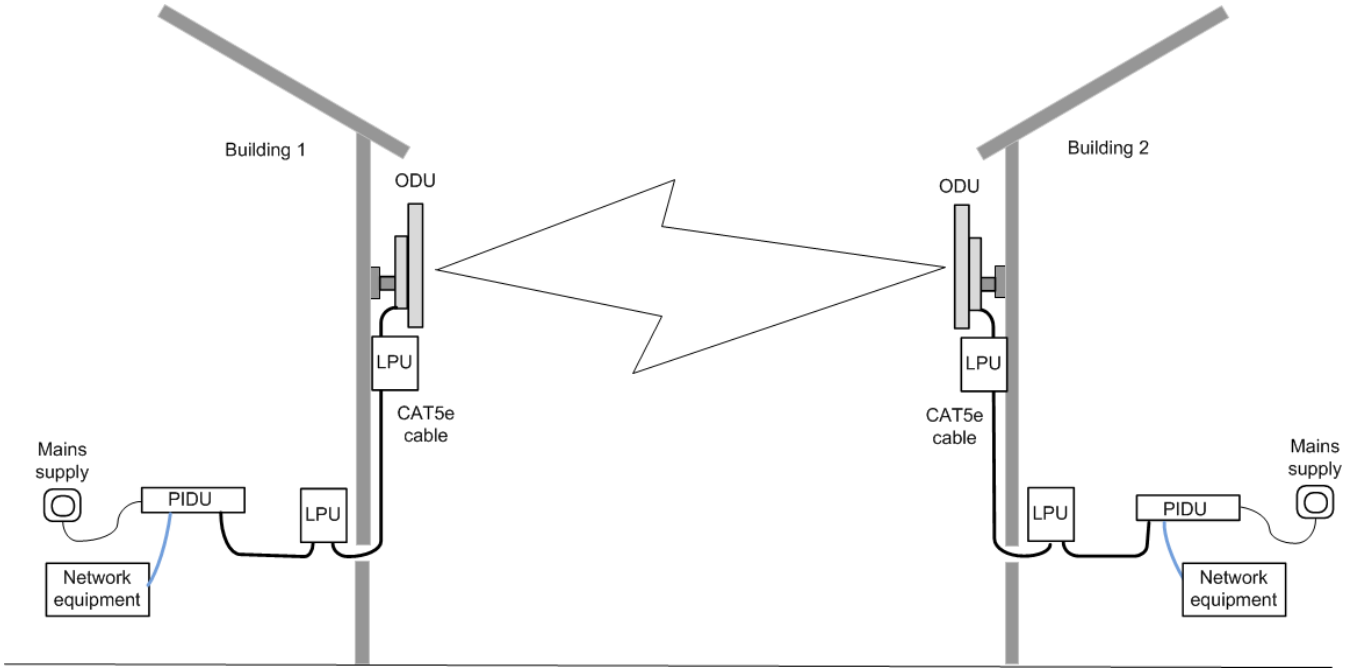
At initialization, the PTP 600 Series monitors the available frequency channels to find a channel that is clear of interference. In operation, the PTP 600 Series continuously monitors the spectrum to ensure it is operating on the cleanest channel.

Typical deployment

The PTP 600 Series Bridge consists of a pair of units, deployed one at each end of the link. The radio link operates on a single frequency channel in each direction using Time Division Duplex (TDD). One unit is deployed as a master and the other as a slave. The master unit takes responsibility for controlling the link in both directions.

The PTP 600 Series Bridge is aimed at a wide range of applications. An example application is an enterprise that has a requirement to connect together the Local Area Network (LAN) of two or more buildings as shown in Figure 1.

Figure 1 Typical bridge deployment (grounding not shown)



System components

Each end of the link consists of:

- **Outdoor Unit (ODU):** An integrated (or connectorized) outdoor transceiver unit containing all the radio and networking electronics.
- **PIDU:** An indoor connection box containing a mains power supply, status indicators and network connection port.
- **Cabling and lightning protection:** Cat5e cables, grounding cables, connectors and lightning protection units (LPU).

Product variants

The PTP 600 Series is available in the following product variants:

- **Frequency variants**: There is a frequency variant for each license exempt frequency band, as well as the licensed 2.5 GHz band in the USA (Table 1). Check that local regulations allow the use of these frequency variants.
- **Integrated or Connectorized**: All frequency variants are available in either Integrated (with attached antenna) or Connectorized (without an antenna) variants.
- **Link Complete or End Complete**: The Link Complete kit consists of two ODUs and two PIDU units, pre-configured as a link. The End Complete kit consists of one ODU and one PIDU unit.
- **Lite or Full**: Some frequency variants are available in either Lite or Full variants. Lite data rates are half those of Full.
- **FCC/IC or ETSI/RoW**: The PTP 54600 and PTP 58600 are available in two regional variants: one is for use in regions where FCC or IC licensing restrictions apply (FCC/IC), and the other is for use in ETSI or the rest of the world (ETSI/RoW).
- **ATEX/Hazloc**: The PTP 54600 and PTP 58600 are available in ATEX/Hazloc variants for operation in selected regions in locations where gas hazards exist, as defined by Hazloc (USA) and ATEX (Europe).
- **OOBM**: The PTP 54600 and PTP 58600 are available in out-of-band management variants in selected regions.

To identify the available combinations of the above variants, refer to PTP 600 kits on page 2-53.

Table 1 PTP 600 Series frequency variants

Variant	Region	Frequency Coverage (MHz)	Channel Bandwidth (MHz)	Channel Raster (MHz)
PTP 25600	FCC BRS-EBS Post-Transition Band	2496-2568	5, 10, 15, 30	5.5
		2572-2614	5, 10, 15, 30	6
		2618-2690	5, 10, 15, 30	5.5
PTP 45600	US Federal	4404-4596	5, 10, 15, 20	6
		4404-4596	30	10
	NTIA	4400-4600	10, 20	6
PTP 48600	US Federal	4710-4940	5, 10, 15, 20	5

Variant	Region	Frequency Coverage (MHz)	Channel Bandwidth (MHz)	Channel Raster (MHz)
	US Federal Extended	4710-5000	5, 10, 15, 20	5
	NTIA	4700-4940	10, 20	5
PTP 49600	USA/Canada Public Safety	4940-4990	5, 10, 20	5
	UK, License Required	4940-4990	5, 10, 20	5
	Hong Kong Public Safety	4900-4950	5, 10, 20	5
	EU Broadband Disaster Recovery	4900-4950	5, 10, 20	5
PTP 54600	ETSI 5 GHz Band B FCC UNII Band	5470-5725	5, 10, 15	6
		5470-5725	30	10
PTP 58600	ETSI 5 GHz Band C FCC ISM Band	5725-5850	5, 10, 15	6
		5725-5850	30	10
PTP 59600	Russia	5825-5925	5, 10, 15	6
			30	10
	India	5875-5925	5, 10, 15	6
			30	10

NOTE

For PTP 25600, channel widths of 30 MHz are available where allowed by local regulations and subject to some restrictions on channel choice.

For PTP 58600 ETSI 5 GHz Band C, use of the product is only allowed where permitted by country-specific regulations.

Outdoor unit (ODU)

This section describes the ODU and its interfaces.

ODU description

The ODU is a self-contained unit that houses both radio and networking electronics. The ODU is supplied in two configurations: integrated (attached to its own flat plate antenna, Figure 2) or connectorized (without an antenna, Figure 3).

Figure 2 PTP 600 Series integrated ODU (front and rear views)

Figure 3 PTP 600 Series connectorized ODU (front and rear views)

Connectorized variant

The connectorized ODU is designed to work with externally mounted antennas that have higher gains than the integrated antenna. Connectorized units can cope with more difficult radio conditions, as described in When to install connectorized units on page 2-17.

ODU interfaces

The ODU interfaces are illustrated in Figure 4 and described in Table 2.

Figure 4 ODU interfaces

Table 2 ODU interfaces

Interface	Function
Ground studs	For grounding the ODU to the supporting structure. The ground cables (supplied with the ODU) may be connected to either ground stud.
E1/T1	RJ45 socket for optional E1 or T1 network connection (not via the PIDU).
AUX (SYNC)	Auxiliary RJ45 socket. In OOBM product variants, this may be used for connection to a management network for out-of-band management. In all product variants, it may be used for connection to an UltraSync GPS timing reference source. This is labeled ‘SYNC’ on older ODUs.
FIBER	Fiber optic socket for optional network connection (not via the PIDU) using a 1000BaseSX Fiber Optic cable.
PIDU+	RJ45 socket for connecting to power supply and network via the PIDU.

Connectorized ODU antenna interfaces

The connectorized ODU also has interfaces to connect to an external antenna (Figure 5) via an N type connector with cable of type LMR100, LMR200, LMR300, LMR400 or LMR600. The ‘V’ interface is for vertical polarization and the ‘H interface is for horizontal polarization.

Figure 5 Connectorized ODU antenna interfaces

Mounting brackets

The ODU is supplied with a bracket for mounting it to a pole of 50mm (2”) to 75mm (3”) in diameter.

The bracket allows for adjustment in both azimuth and elevation. The bracket may be split to allow the pole mount section of the bracket to be mounted to the pole first. This allows the installer to take the weight of the unit and secure it, one handed, with a single mounting bolt.

Network connection

The network connection to a PTP 600 Series is made via a 1000BaseT Ethernet connection. Power is provided to the ODU over the 1000BaseT Ethernet connection using a patented non-standard powering technique.

Very early releases of the PTP 600 Series platform used different powering and connection arrangements. Users of equipment prior to Mod Record 1 should refer to the User Guide shipped with the original equipment. The Mod Record label can be found on the back of the ODU as shown in Figure 6.

Figure 6 Mod record label

Fiber optic connection

Alternatively, the network connection to a PTP 600 Series can be made using a 1000BaseSX or 1000BaseLX fiber Optic cable connected directly to the ODU. In this case power is still provided over the 1000BaseT Ethernet connection. If the fiber optic cable fails, the PTP 600 automatically falls back to the copper Ethernet connection, provided that the cable length does not exceed 100 m (330 ft). PTP 600 Series Fiber Interface Upgrade Kits can be obtained from your distributor, reseller or system integrator.

For more information, refer to the PTP 600 Series Optical Interface Upgrade Guide.

Further reading on the ODU

For more information on the ODU, refer to the following:

- ODU site selection on page 2-6 describes how to select a site for the ODU.
- When to install connectorized units on page 2-17 describes when to choose connectorized ODUs and external antennas rather than integrated ODUs.
- General protection requirements on page 2-23 describes the grounding and lightning protection requirements of a PTP 600 installation, including the ODU.
- Ordering components on page 2-53 lists the components required for PTP 600 installations, including ODUs, with Cambium part numbers.
- FCC and IC approved antennas on page 2-64 contains specifications of the antennas that may be used with connectorized ODUs.
- ODU specifications on page 4-2 contains specifications of the ODU such as dimensions, weight and environmental requirements.
- Installing the ODU and top LPU on page 5-4 describes how to install the ODU (integrated or connectorized) on the supporting structure.
- Installing connectorized antennas on page 5-10 describes how to install separate antenna(s) for a connectorized ODU.
- Task 11: Aligning antennas on page 6-85 describes how to align the antennas for both integrated and connectorized ODUs.

Powered indoor unit (PIDU)

This section describes the PIDU Plus PTP 300/500/600 Series and its interfaces.

PIDU description

The PIDU generates the ODU supply voltage from the mains supply (or from an external DC source) and injects this supply voltage into the ODU.

The PIDU is connected to the ODU and network equipment using Cat5e cable with RJ45 connectors.

The ODU should only be deployed using the supplied PIDU Plus PTP 300/500/600 Series.

⚠ CAUTION

The PIDU ODU port is designed to connect only to PTP 300, PTP 500 or PTP 600 ODUs, LPUs or PTP-SYNC units. Do not connect any other equipment, as damage may occur. The PIDU Plus PTP 300/500/600 Series is not interchangeable with the PIDU Plus PTP 400 Series.

PIDU interfaces

The PIDU interfaces are illustrated in Figure 7 and described in Table 3 and Table 4.

Figure 7 PIDU interfaces

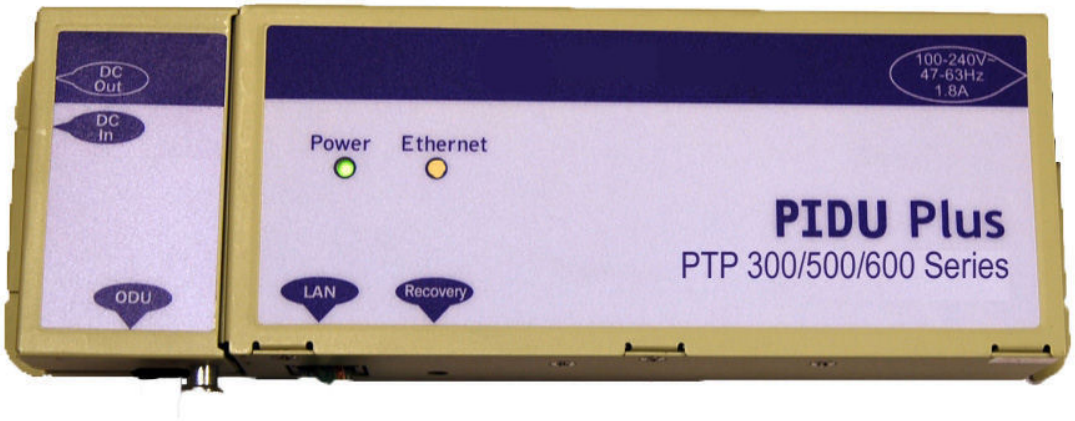


Table 3 PIDU interface functions

Interface	Function
100-240V 47-63Hz 1.8A	Mains power input.
DC In	Alternative DC power supply input. Refer to Redundancy and alternative powering configurations on page 1-14.
DC Out	DC power output to a second PIDU. Used to provide power supply redundancy. Refer to Redundancy and alternative powering configurations on page 1-14.
ODU	RJ45 socket for connecting Cat5e cable to ODU.
LAN	RJ45 socket for connecting Cat5e cable to network.
Recovery	Used to recover the unit from configuration errors or software image corruption.

Table 4 PIDU LED functions

LED	Function
Power (green)	Power supply detection
Ethernet (yellow)	Ethernet traffic detection

NOTE

For a full list of LED states and fault-finding actions, refer to Testing link end hardware on page 8-2.

Redundancy and alternative powering configurations

The PTP 600 Series can be powered from an external DC source and can be provided with power supply redundancy as follows:

- External DC supply only (Figure 8): This configuration is for use where there is no mains supply.
- External DC supply and AC supply (Figure 9): This configuration provides redundancy through the use of mains and DC supply.
- External DC supply and redundant AC Supply (Figure 10): This configuration guards against mains failure and failure of the DC output of one PIDU.

Figure 8 External DC supply only

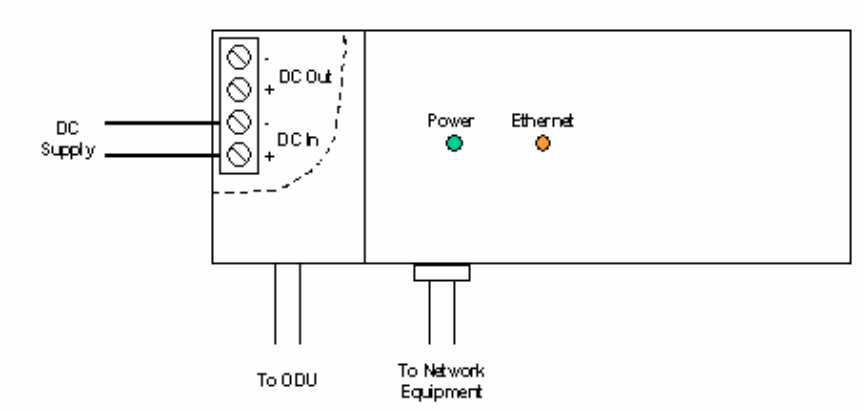


Figure 9 External DC supply and AC supply

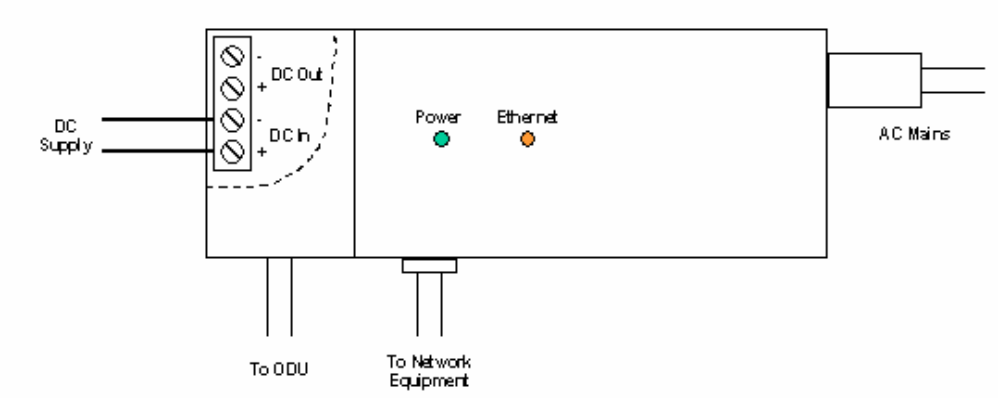
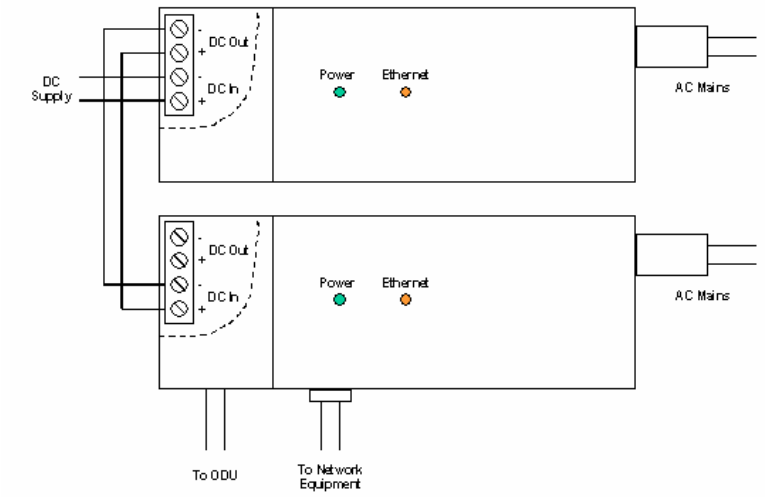


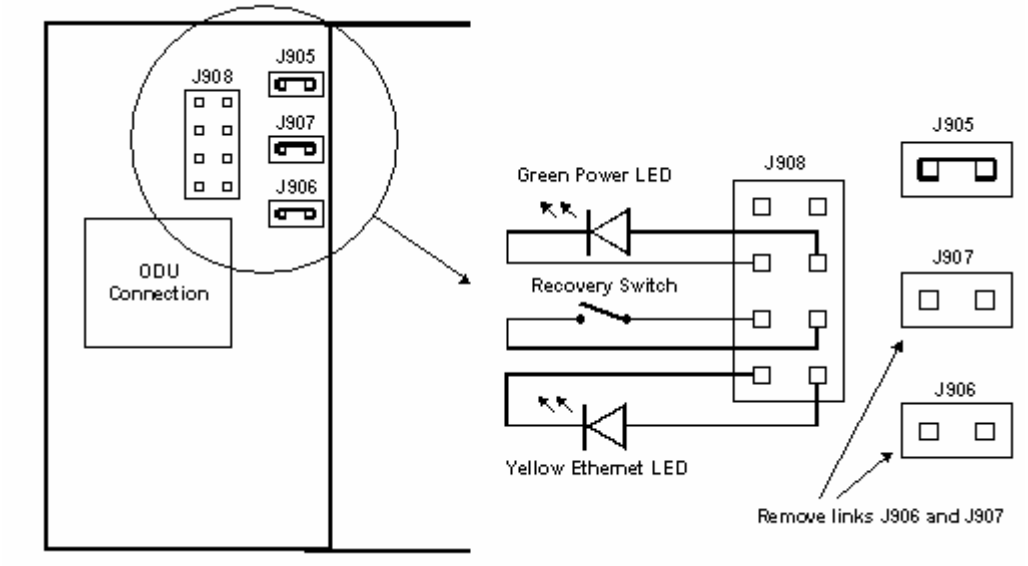
Figure 10 External DC supply and redundant AC supply



Remote LEDs and recovery switch

The PIDU provides a facility to connect remote LEDs and Recovery switch allowing the PIDU to be mounted inside an enclosure. At the left hand end of the PIDU under the ODU connection cover can be found a PCB header and three jumpers. Jumpers J906 and J907 should be removed and connection to the remote LEDs and Recovery switch made to J908 as shown in Figure 11.

Figure 11 Remote LED and recovery switch wiring



Further reading on the PIDU

For more information on the PIDU, refer to the following:

- PIDU site selection on page 2-6 describes how to select a location for the PIDU.
- Ordering components on page 2-53 lists the components required for PTP 600 installations, including PIDU units, with Cambium part numbers.
- PIDU specifications on page 4-3 contains specifications of the PIDU such as dimensions, weight, environmental and electrical requirements.
- Installing the PIDU on page 5-29 describes how to install the PIDU, connect it to the ODU, and prepare the network cables.
- Task 1: Connecting to the unit on page 6-3 describes how to connect the PIDU to a management PC to allow configuration and alignment of the PTP 600.
- Task 15: Connecting link to the network on page 6-99 describes how to connect the PIDU to the network when configuration, installation and alignment are complete.
- Testing link end hardware on page 8-2 describes how the PIDU is used when testing the link end hardware for suspected faults.

Cabling and lightning protection

This section describes the cabling and lightning protection components of a PTP 600 installation.

PTP and lightning protection

The PIDU meets the low level static discharge specifications identified in Electromagnetic compatibility (EMC) compliance on page 4-51 but does not provide lightning or surge suppression.

The amount of lightning protection is dependent on regulatory requirements and the end user requirements. The standard ODU for the PTP 600 Series is fitted with surge limiting circuits and other features to minimize the risk of damage due to nearby lightning strikes. To be fully effective, these standard features require some additional equipment to be configured as part of the system installation.

⚠ WARNING

The units are not designed to survive direct lightning strike. For this reason they must not be installed in 'Zone A', as defined in Grounding and lightning protection on page 2-21. Mounting in Zone A may put equipment, structures and life at risk.

Outdoor connections

The term 'drop cable' refers to the cable that is used for all connections that terminate outside the building, for example, connections between the ODU, LPUs (if installed), GPS receiver (if installed) and the ODU port of the PIDU.

⚠ CAUTION

For outdoor connections, always use Cat5e cable that is gel-filled and shielded with copper-plated steel. This is the only type of outdoor drop cable supported in this application.

Indoor connections

The Cat5e cable that connects the PIDU to the network equipment must meet the following requirements:

- **Screening**: Must be either foil screen (FTP) or braided screen (STP) cable.
- **Connectors**: Must use screened RJ45 connectors with metal shells at both ends.
- **Electrical connection**: There must be a continuous electrical connection between both screened connectors.

CAUTION

The connected network equipment must feature screened RJ45 connectors and must be connected to ground, otherwise the PIDU will not be grounded, and this may increase the levels of unwanted radiation from the ODU - PIDU cables.

NOTE

The ODU network connection implements automatic MDI/MDI-X sensing and pair swapping, allowing connection to networking equipment that requires cross-over cables (MDI-X networks) or straight-through cables (MDI Networks).

Cable grounding kits

Drop cables must be grounded at the points specified in Grounding and lightning protection on page 2-21. One cable grounding kit (Figure 12) is required for each drop cable grounding point.

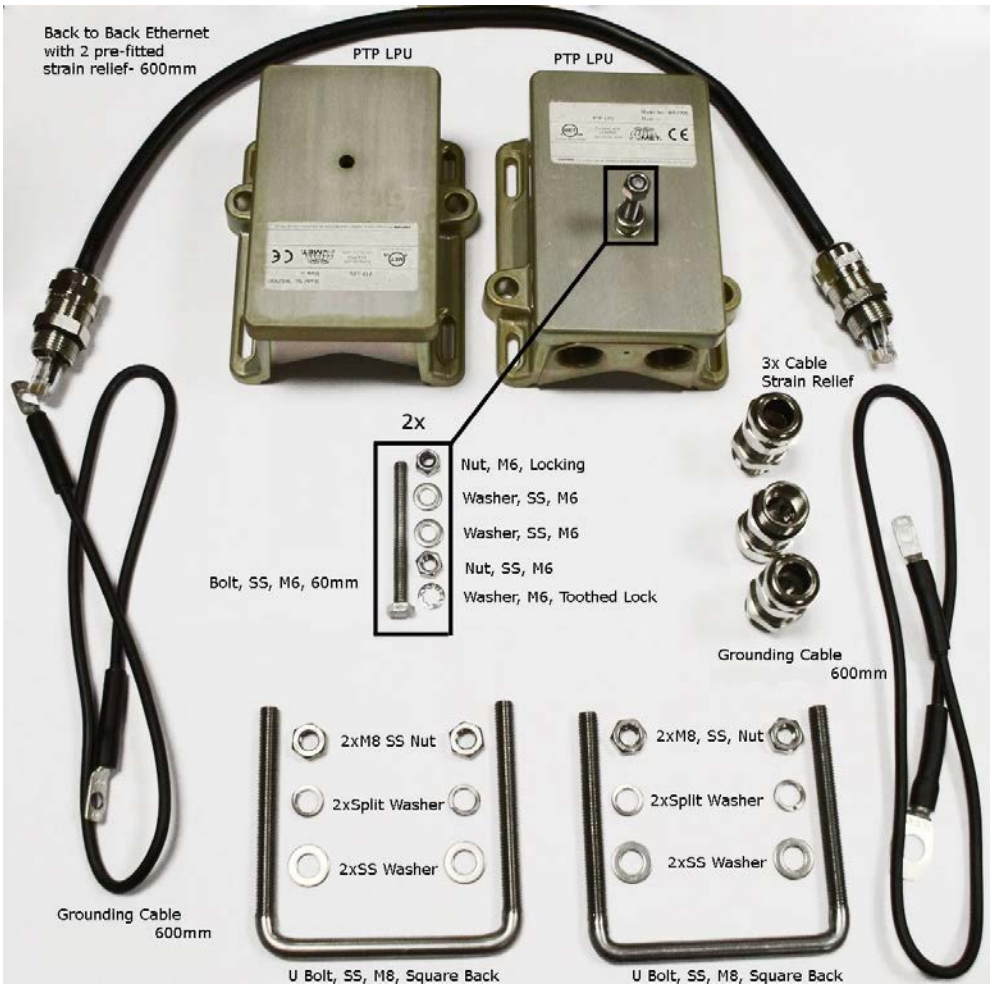
Figure 12 Cable grounding kit for 1/4” and 3/8” cable

Lightning protection units (LPUs)

LPU double end kit

The LPU double end kit (Figure 13) is required for ODU drop cables. One LPU is installed next to the ODU and the other is installed near the point at which the drop cable enters the building.

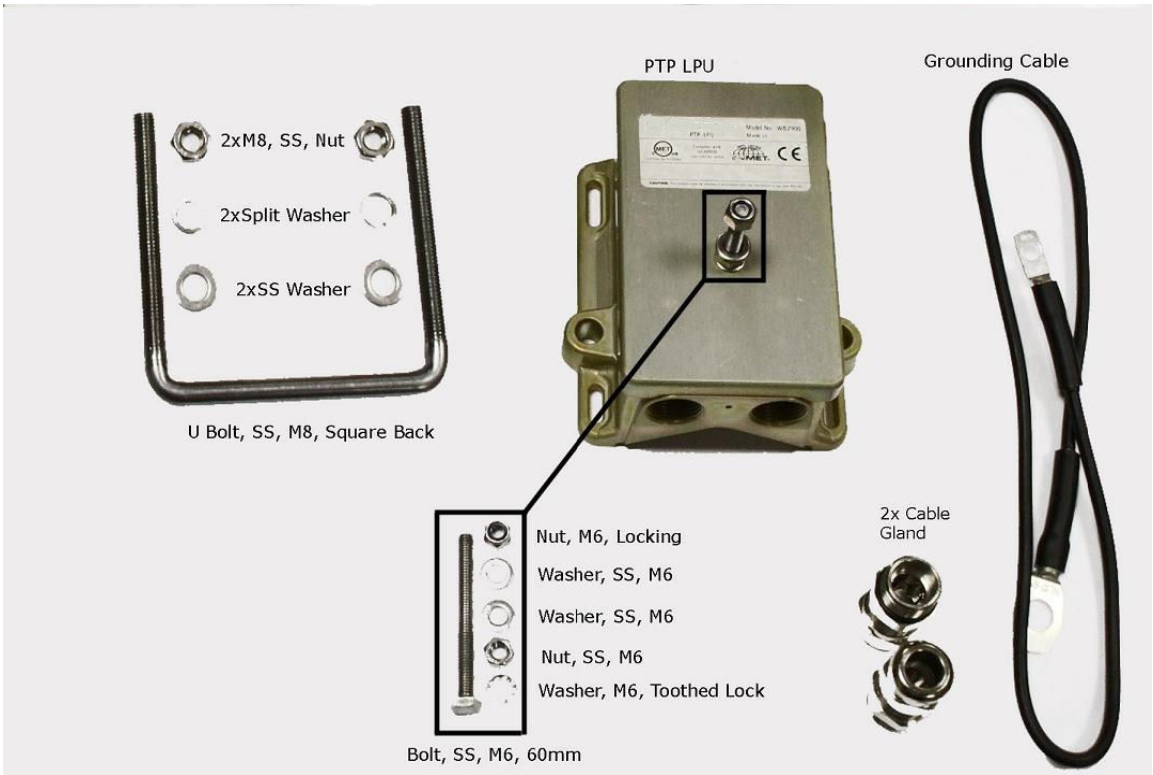
Figure 13 LPU double end kit



LPU single end kit

The LPU single end kit (Figure 14) is required for GPS drop cables, when GPS is the timing reference source for PTP-SYNC (optional). The LPU is installed near the point at which the drop cable enters the building.

Figure 14 LPU single end kit



Further reading on cabling and lightning protection

For more information on cabling and lightning protection, refer to the following:

- Maximum cable lengths on page 2-7 gives maximum permitted lengths of interface cables in PTP 600 installations.
- Grounding and lightning protection on page 2-21 describes the grounding and lightning protection requirements of a PTP 600 installation.
- Ordering components on page 2-53 lists the components required for PTP 600 installations, including cables, connectors, grounding kits and LPUs.
- Installing the drop cable and bottom LPU on page 5-16 describes how to install the drop cable from the ODU to the LPU and PIDU, and to provide grounding for the installation.
- Installing the PIDU on page 5-29 describes how to prepare the indoor cables to connect to the network.

PTP-SYNC unit

This section describes the (optional) PTP-SYNC unit and its interfaces. This unit may be used to implement TDD synchronization.

PTP-SYNC unit description

The PTP-SYNC unit (Figure 15) is an optional component. It is required when TDD synchronization is implemented using PTP-SYNC. It measures the difference between the TDD frame timing and a 1 Hz timing reference, and signals this time difference to the ODU.

For more information on this feature, refer to TDD synchronization on page 1-34.

The PTP-SYNC is a compact indoor unit mounted on a wall or a shelf or (using an optional rack mounting adaptor) in a standard 19 inch rack. It is powered using standard power-over-Ethernet from the PIDU. One PTP-SYNC unit is required for each synchronized link.

Figure 15 PTP-SYNC kit

Model number

The PTP-SYNC model number (for example WB3665BB or WB3665AA) is located underneath the unit, on the bar code label.

NOTE

Legacy installations may incorporate PTP-SYNC model number WB3665AA. This model does not provide all of the LED states that are available in later models. Installations with this model are subject to shorter maximum cable lengths (see Maximum cable lengths on page 2-7).

PTP-SYNC unit interfaces

The PTP-SYNC front panel is illustrated in Figure 16. The annotated interfaces are described in Table 5 and Table 6.

Figure 16 PTP-SYNC front panel

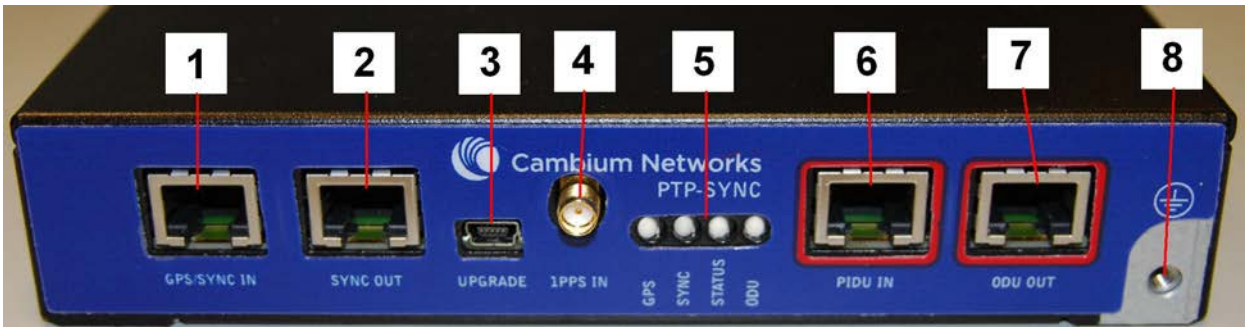


Table 5 PTP-SYNC interface functions

Number	Description	Function
1	GPS/SYNC IN	Input from GPS receiver or from the daisy-chained SYNC OUT signal of another PTP-SYNC.
2	SYNC OUT	Output to daisy-chained PTP-SYNC units.
3	USB	Input for software upgrades. Contact Cambium for instructions.
4	1PPS IN	Coaxial alternative to GPS/SYNC IN. Peak input voltage must not exceed 5 V.
5	LED bank	LEDs and their functions are described in Table 6.
6	PIDU IN	Input from PIDU.
7	ODU OUT	Output to ODU.
8	Ground stud	For connecting to a ground point.

Table 6 PTP-SYNC LED functions

LED	Function
GPS	GPS satellite data detection.
SYNC	SYNC OUT port data detection.
STATUS	Power and satellite lock detection.
ODU	ODU signal detection.

> **NOTE**
> For a full list of LED states and fault-finding actions, refer to Testing PTP-SYNC on page 8-13.

Further reading on PTP-SYNC

For more information on PTP-SYNC and TDD synchronization, refer to the following:

- TDD synchronization on page 1-34 describes how TDD synchronization is achieved using PTP-SYNC.
- PTP-SYNC site selection on page 2-7 describes factors to be considered when choosing sites for the PTP-SYNC unit.
- Configuration options for TDD synchronization on page 2-30 describes the different TDD synchronization methods that may be implemented using PTP-SYNC.
- Mounting options for the PTP-SYNC GPS receiver on page 2-34 describes the requirements of the (optional) GPS receiver for PTP-SYNC.
- Ordering components on page 2-53 lists the components required for PTP 600 installations, including PTP-SYNC and GPS units, with Cambium part numbers.
- PTP-SYNC specifications on page 4-4 contains specifications of the PTP-SYNC unit that is supplied by Cambium for PTP 600 installations.
- Installing a PTP-SYNC unit on page 5-32 describes how to install a PTP-SYNC unit.
- Installing a GPS receiver for PTP-SYNC on page 5-37 describes how to install an optional GPS receiver for PTP-SYNC.
- Task 6: Configuring wireless and telecoms interfaces on page 6-45 describes how to configure TDD synchronization.
- Testing PTP-SYNC on page 8-13 describes how to test a PTP-SYNC installation when a fault is suspected.

Wireless operation

This section describes how the PTP 600 wireless link is operated, including modulation modes, power control and security.

Time division duplexing

TDD cycle

PTP 600 links operate using Time Division Duplexing (TDD). They use a TDD cycle in which the ODUs alternately transmit and receive TDD bursts. The TDD cycle is illustrated in Figure 17. The steps in the cycle are as follows:

1. The TDD master transmits a burst to the TDD slave.
2. A delay occurs as the master-slave burst propagates over the link.
3. The slave receives the burst from the master.
4. The slave processes the master-slave burst.
5. The slave transmits a burst to the master.
6. A delay occurs as the slave-master burst propagates over the link.
7. The master receives the burst from the slave.
8. The master transmits the next burst to the slave.

TDD frame parameters

The TDD burst duration varies depending on the following:

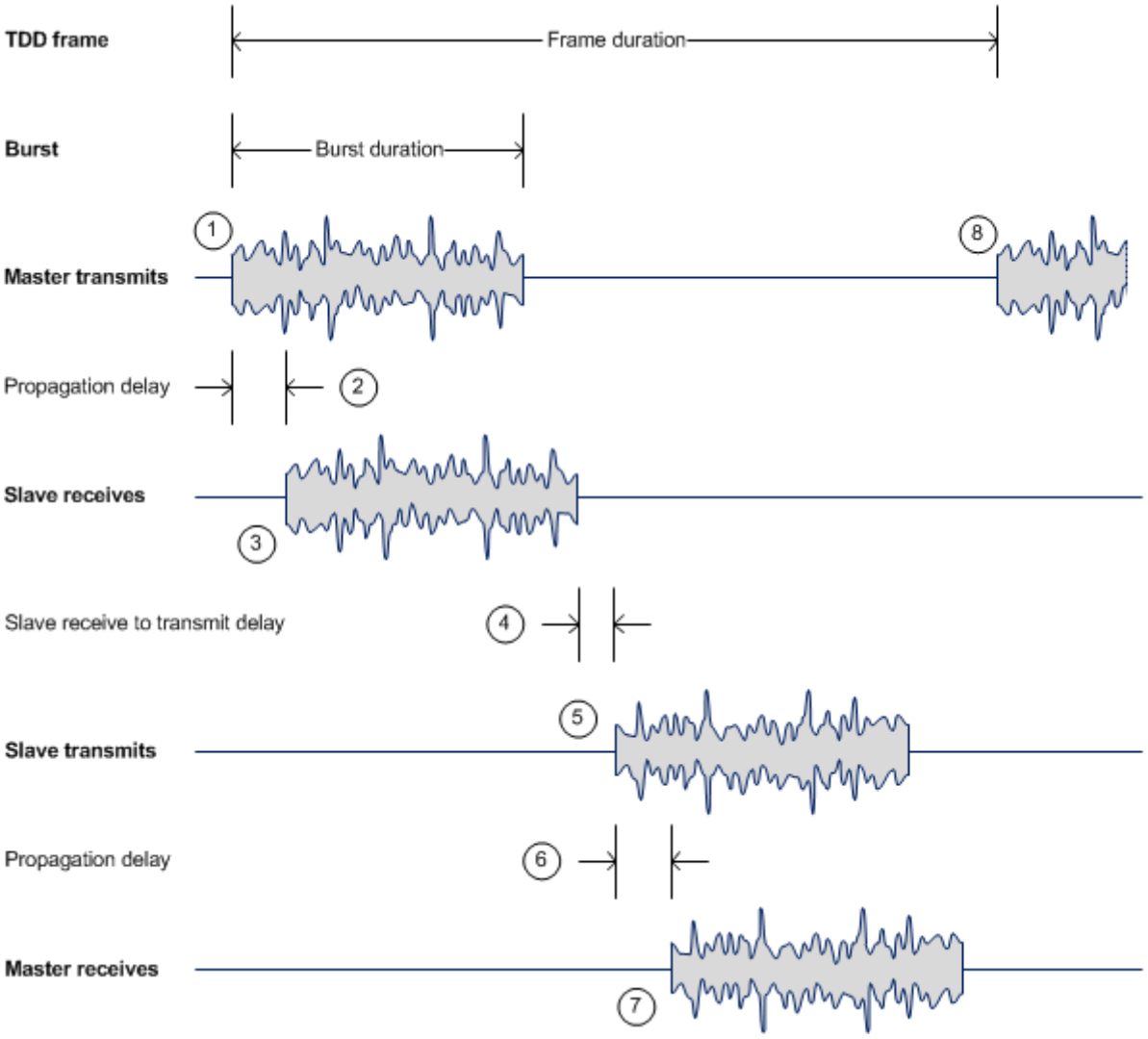
- Channel bandwidth
- Link range
- Link optimization mode
- Link symmetry
- Offered traffic loading.

The TDD frame duration varies depending on the following:

- TDD burst duration master-slave.
- TDD burst duration slave-master.
- Link range.

The propagation delay in Step 2 is necessarily equal to the propagation delay in Step 6, and is determined solely by the link range. There will be added delays between rx and tx on the master and slave to minimize interference, as set up by the link planner or installer.

Figure 17 TDD cycle



Channel selection

The PTP 600 series links are capable of transmitting and receiving on the same channel or on different channels. In other words, the slave-master direction may use a different channel from the master-slave direction. Independent selection of transmit and receive frequencies can be useful in planned networks or for countering interference.

When links operate in radar avoidance regions, each unit must monitor its transmit channel for the presence of radar signals, and thus transmit and receive channels are always identical.

Link mode optimization

Link mode optimization allows the PTP 600 link to be optimized according to the type of traffic that will be bridged. The link supports two modes, IP Traffic and TDM Traffic.

IP traffic

IP Traffic mode is optimized to provide the maximum possible link capacity. IP Traffic mode is an appropriate choice where applications in the bridged networks provide some measure of reliable transmission, and where very low latency is not critical. IP mode supports both fixed and adaptive link symmetry (see Link symmetry on page 1-27).

TDM traffic

TDM Traffic mode is optimized to provide the lowest possible latency. TDM Traffic mode additionally implements a more conservative approach to adaptive modulation, leading to lower error rates in fading channels at the expense of slightly lower link capacity. TDM Traffic mode is an appropriate choice for delay intolerant data without reliable transmission (for example voice over IP data). TDM mode is selected automatically when Telecom interfaces are enabled.

Link symmetry

The PTP 600 series provides four configuration options for apportioning the available capacity between the two link directions.

- **Symmetric:** The Master and Slave have equal capacity. The PTP 600 series achieves this by allocating an equal Burst Duration for the Master and the Slave.
- **2:1** The capacity in the direction Master to Slave is twice that of the direction Slave to Master. The PTP 600 series achieves this by setting the Burst Duration of the Master to twice that of the Slave.
- **1:2** The capacity in the direction Slave to Master is twice that of the direction Master to Slave. The PTP 600 series achieves this by setting the Burst Duration of the Slave to twice that of the Master.

NOTE

The 2:1 and 1:2 modes are not available when TDD synchronization is enabled or when 5 MHz bandwidth is selected.

- **Adaptive:** The capacity allocated to a given link direction is dependent on the offered level of network traffic in both link directions. If the level of offered traffic in both directions is equally high or equally low, the PTP 600 will allocate equal capacity to both directions. If however the offered level of traffic is greater in one direction, it is allocated a greater proportion of the overall link capacity. The PTP 600 series achieves this by increasing (or decreasing) the duration of the Transmit Burst in a given link direction as the offered level of network traffic increases (or decreases) in this same direction. This is done independently for the two directions.

  Adaptive mode is not available in the following configurations:

  - When link mode optimization is set to TDM Traffic (see Link mode optimization on page 1-27).
  - When TDD synchronization is enabled.
  - In regions where radar avoidance is operational (see Radar avoidance on page 1-31).
  - When 5 MHz bandwidth is selected.

OFDM and channel bandwidth

The PTP 600 series transmits using Orthogonal Frequency Division Multiplexing (OFDM). This wideband signal consists of many equally spaced sub-carriers. Although each sub carrier is modulated at a low rate using conventional modulation schemes, the resultant data rate from all the sub-carriers is high. OFDM works exceptionally over a Non-Line-of-Sight (NLoS) channel.

The channel bandwidth of the OFDM signal is configurable to one of five values: 5 MHz, 10 MHz, 15 MHz, 20 MHz and 30 MHz. Higher bandwidths provide greater link capacity at the expense of using more spectrum. Systems configured for a narrower channel bandwidth provide better receiver sensitivity and can also be an appropriate choice in deployments where the amount of free spectrum is limited.

Each channel is offset in center frequency from its neighboring channel by 10 MHz or 6 MHz.

NOTE

The Channel Bandwidth must be configured to the same value at both ends of the link.

Not all channel bandwidths are available in all regions or all frequency variants.

Spectrum management

The spectrum management feature of the PTP 600 Series monitors the available wireless spectrum and directs both ends of the wireless link to operate on a channel with a minimum level of co-channel and adjacent channel interference.

Spectrum management measurements

The PTP 600 Series performs two mean signal measurements per TDD cycle, per channel. This mean measurement represents the mean received signal power for the 40 microsecond measurement period.

The Spectrum Management algorithm collects measurements equally from all channels. This process is called the Channel Availability Check (hereafter referred to by the acronym CAC). The CAC uses a round-robin channel selection process to collect an equal amount of measurements from each channel. The CAC measurement process is not altered by the channel barring process. Measurements are still collected for all channels irrespective of the number of barred channels.

Measurement analysis

Spectrum Management uses statistical analysis to process the received peak and mean measurement. The statistical analysis is based on a fixed, one minute, measurement quantization period. Spectrum Management collects data for the specified quantization period and only at the end of the period is the statistical analysis performed. The analysis produces three key metrics for each channel:

- Peak of Means
- 99.9% Percentile of the Means
- Mean of Means

These metrics are defined in Interpreting the spectrum management plots on page 7-24.

Statistical summary

The display of statistical measurement on the spectrum management page always shows a statistical summary of all channel measurement. The statistical summary is controlled by the Statistics Window attribute. This attribute defaults to a value of twenty minutes, which means that the mean and percentile values displayed for each channel are calculated over the 20 minute period. All channel decisions are made using the values computed over the statistics window period.

Spectrum management in fixed frequency mode

The transmit and receive frequencies can be fixed in a PTP 600 wireless link. Once fixed frequency mode is configured, the spectrum management software will not attempt to move the wireless link to a channel with lower co-channel and adjacent-channel interference. Therefore this mode of operation is only recommended for deployments where the installer has a good understanding of the prevailing interference environment (see Step 2: Wireless configuration on page 6-51). Care must also be taken to ensure that the frequency allocations at each end of the link are compatible.

Fixed frequency mode is not available in regions where radar detection is required by the regulations.

Adaptive modulation

The PTP 600 series can transport data over the wireless link using a number of different modulation modes ranging from 256QAM 0.81 to BPSK 0.63. For a given channel bandwidth and TDD frame structure, each modulation mode transports data at a fixed rate. Also, the receiver requires a given signal to noise ratio in order to successfully demodulate a given modulation mode. Although the more complex modulations such as 256QAM 0.81 will transport data at a much higher rate than the less complex modulation modes, the receiver requires a much higher signal to noise ratio.

The PTP 600 series provides an adaptive modulation scheme where the receiver constantly monitors the quality of the received signal and notifies the far end of the link of the optimum modulation mode with which to transmit. In this way, optimum capacity is achieved at all times. This is one of a number of features which allows the PTP 600 to operate in challenging non-line of sight radio channels.

Specifications of capacity for all channel bandwidths, modulation modes and configurations are provided in Data throughput capacity on page 4-74.

Specifications of receive level thresholds for each modulation mode (assuming no interference) are provided in the various system threshold tables in Chapter 4: Reference information.

> **NOTE**
> PTP LINKPlanner includes an estimate of mean data rate, the data rate provided by each modulation and the percentage of time spent in each modulation mode.

MIMO

Multiple-Input Multiple-Output (MIMO) techniques provide protection against fading and increase the probability that the receiver will decode a usable signal. When the effects of MIMO are combined with those of OFDM techniques and a high link budget, there is a high probability of a robust connection over a non-line-of-sight path.

The PTP 600 transmits two signals on the same radio frequency, one of which is vertically polarized and the other horizontally polarized. The PTP 600 also has the ability to adapt between two modes of operation:

- **Dual Payload**: When the radio channel conditions allow, the PTP 600 will transmit two different and parallel data streams, one on the vertical channel and one on the horizontal channel. This doubles the capacity of the PTP 600.

- **Single Payload**: As the radio channel becomes more challenging, the PTP 600 has the ability to detect this and switch to a mode which transmits the same data stream on both vertical and horizontal channels. This provides polar diversity and is another key feature which allows the PTP 600 to operate in challenging non- line of sight radio channels.

The two modes have been implemented by the introduction of two sets of modulation modes. The lower order modulations (BPSK 0.63 up to QPSK 0.87) are only available as single payload modes. Each of the higher order modulations (16QAM 0.63 to 256QAM 0.81) are available in single payload mode and dual payload mode. The switching between modes is automatically controlled by the adaptive modulation feature described in Adaptive modulation on page 1-30.

NOTE

The system automatically chooses between dual and single payload to try to increase the capacity of a link. However the user can disable the dual payload mode, forcing the more robust option of single payload.

Intelligent dynamic frequency selection

The PTP 600 series uses an interference mitigation technique known as Intelligent Dynamic Frequency Selection (i-DFS) (not available in the 2.5 GHz band). Both the Master and Slave continually monitor for interference on all channels and then select the best frequency of operation. This is a dynamic process where the PTP 600 can continually move channels in response to changes in interference. Two modes of operation are available:

- First mode: the two link directions are forced to select the same frequency, determined by the Master.
- Second mode: the frequency of operation can be determined independently for each direction. This mode is not permitted in radar regions.

Radar avoidance

In regions where protection of radars is part of the local regulations, the PTP 600 must detect interference from radar-like systems and avoid co-channel operation with these systems.

To meet this requirement, the PTP 600 implements the following features:

- The equipment can only transmit on available channels, of which there are none at initial power up. The radar detection algorithm will always scan a usable channel for 60 seconds for radar interference before making the channel an available channel.
- This compulsory channel scan will mean that there is at least 60 seconds service outage every time radar is detected and that the installation time is extended by at least 60 seconds even if there is found to be no radar on the channel

- When operating on a channel, the spectrum management algorithm implements a radar detection function which looks for impulsive interference on the operating channel. If impulsive interference is detected, spectrum management will mark the current operating channel as having detected radar (unavailable channel) and initiate a channel hop to an available channel. The previous operating channel will remain in the unavailable state for thirty minutes after the impulsive interference pulse was detected.
- After the thirty minutes have expired the channel will be returned to the usable channel pool.

There is a secondary requirement for bands requiring radar avoidance. Regulators have mandated that products provide a uniform loading of the spectrum across all devices. In general, this prevents operation with fixed frequency allocations. However:

- ETSI regulations do allow frequency planning of networks (as that has the same effect of spreading the load across the spectrum).
- The FCC does allow channels to be barred if there is actually interference on them.

NOTE
Fixed frequency allocation is not recommended in radar avoidance regions, as any radar detection would cause a system outage of at least 30 minutes.

Encryption

The PTP 600 supports optional encryption for data transmitted over the wireless link. The encryption algorithm used is the Advanced Encryption Standard (AES) with 128-bit and 256-bit key size. AES is a symmetric encryption algorithm approved by U.S. Government organizations (and others) to protect sensitive information. The AES implementation in PTP 600 is approved to FIPS-197.

Encryption is enabled through the purchase of an upgrade.

Region codes

Some aspects of wireless operation are controlled, enforced or restricted according to a region code. PTP 600 region codes represent individual countries (for example Denmark) or regulatory regions (for example FCC or ETSI).

Region codes affect the following aspects of wireless operation:

- Maximum transmit power
- Radar avoidance
- Transmit power reduction in edge channels
- Frequency range

- Channel plan

A region code is encoded in the PTP 600 license key. The region code can be changed by generating and entering a new license key.

NOTE

Some units are supplied with two alternative license keys for different region codes, one of which is factory configured.

CAUTION

To avoid possible enforcement action by the country regulator, always operate links in accordance with local regulations.

PTP networks

Using Intelligent Dynamic Frequency Selection

The Intelligent Dynamic Frequency Selection (i-DFS) feature allows a PTP 600 unit to select wireless channels for a lower level of radio frequency (RF) interference. This approach is appropriate where the network consists of a small number of PTP links, or where the RF interference is predominantly from equipment belonging to other operators.

Using frequency planning

Networks will benefit from the use of fixed channel allocations if (a) the network consists of multiple PTP links, and (b) RF interference predominantly arises from equipment in the same network.

Frequency planning is the exercise of assigning operating channels to PTP units so as to minimize RF interference between links. Frequency planning must consider interference from any PTP unit to any other PTP unit in the network. Low levels of interference normally allow for stable operation and high link capacity.

The frequency planning task is made more straightforward by use of the following techniques:

- Using several different channels
- Separating units located on the same mast
- Using high performance (directional) external antennas

For help with planning networks, refer to Chapter 2: Planning considerations, or contact your Cambium distributor or re-seller.

Synchronized networks

TDD synchronization can be used to relax constraints on the frequency planning of PTP networks. Synchronization has the following benefits:

- Allows tighter frequency re-use, and thus wider channel bandwidth.
- Allows more convenient collocation of units on a single mast.
- Allows use of smaller or lower performance antennas.
- Reduces inference, resulting in use of more efficient modulation modes.

In a correctly designed synchronised network, all links are configured with the same TDD frame duration, and the TDD frame contains guard periods longer than the propagation delay between the most distant interfering units.

Each synchronized unit is assigned to one of two phases. A master ODU can be assigned to either phase. A slave ODU must be assigned to a different phase from the associated master ODU. The phase is set by suitable configuration of TDD Frame Offset.

TDD synchronization eliminates RF interference between units in the same phase. This means that frequency planning in a synchronized network is concerned only with interference between units in different phases. Frequency planning is still necessary, but the number of potential interference paths to be considered is halved. Frequency planning in a synchronized TDD network has approximately the same level of complexity as frequency planning in a Frequency Division Duplex (FDD) network.

TDD synchronization

Additional hardware

Additional hardware is needed to synchronize PTP 600 links. Two alternative approaches are supported:

- **MemoryLink UltraSync GPS receiver:** This unit contains a GPS receiver producing a 1 Hz timing reference locked to the GPS network. The UltraSync unit is connected directly to the Sync input at the master ODU. One UltraSync unit is required for each synchronized link.
- **PTP-SYNC**: This option is the preferred solution. One PTP-SYNC unit is required for each master ODU. The PTP-SYNC unit is connected in line in the drop cable between the PIDU and the ODU, and is collocated with the PIDU.

NOTE

PTP 600 System Releases earlier than 600-08-04 do not support PTP-SYNC.

Timing references for use with PTP-SYNC

PTP-SYNC requires an external timing reference in all but the simplest networks. Up to ten PTP-SYNCs can be connected in a chain to share the timing signal from one timing reference. In the majority of applications, one reference is required for each site that contains PTP 600 master ODUs.

The timing reference can be from any timing system that provides a 1 Hz signal, accurately synchronized in frequency and phase with a network-wide master timing reference. GPS timing receivers are a very practical way of obtaining a suitable reference. The PTP-SYNC is compatible with the following GPS timing receivers:

- Trimble Acutime™ Gold GPS receiver

In simple networks where all master ODUs are at a single site, the external reference can be omitted. In this case, one ODU acts as a reference for other collocated units.

Configuring the TDD frame

In synchronized operation, frame duration and burst duration must be configured directly in the web-based management interface. Frame duration must be identical across all links in a synchronized network.

The PTP Link Planner provides a capability for computing suitable frame parameters in a synchronized network. Please refer to the *Link Planner User Guide* for guidance on configuring TDD synchronization.

Link symmetry is always 1:1 in synchronized networks.

Link capacity in synchronized networks

The TDD frame duration is extended in synchronized networks to allow for the propagation delay of the longest link in the network and to incorporate additional guard periods. These guard periods protect against delayed interference from distant units in the same network.

The longer frame duration results in slightly lower link capacity than for an equivalent non-synchronized link with the same channel bandwidth and modulation mode. However, TDD synchronization also reduces interference, and this may allow operation in higher modulation modes. The benefit of operating in a higher modulation mode normally outweighs the penalty of the slightly longer TDD frame.

Advantages of PTP-SYNC over UltraSync

PTP-SYNC has several advantages over the UltraSync solution:

- PTP-SYNC does not require individual GPS receivers, nor must they be located close to the ODUs. This reduces the complexity and the cost of the installation on the mast.
- The GPS receiver can be located anywhere with a clear view of the sky, offering additional flexibility in the installation.

- The PTP-SYNC solution is compatible with standard 1 Hz interfaces, allowing an operator to take advantage of alternative timing references that may be already present at the site.
- The recommended GPS receiver continues to provide accurate timing even after the number of received satellites has dropped down to one, leading to significantly better availability of the reference signal.
- The PTP-SYNC offers the possibility of creating synchronized single-hub networks where no GPS receiver is required.

Installation armed state

The PTP 600 must be armed before installation or alignment of a link using the Installation Wizard. In the installation armed state, the modulation mode is fixed at BPSK 0.63 Single, and the TDD frame duration is extended to allow the link to acquire at unknown range. PTP 600 must be disarmed following successful installation to allow ACM to operate normally.

The Installation Wizard also provides an option to make configuration changes without arming. This option is useful where configuration will be modified in an existing link without changing alignment or link range.

Further reading on wireless operation

For information on planning wireless operation, refer to the following:

- Regulatory planning on page 2-2 describes the regulatory restrictions that affect radio spectrum usage, such as frequency range and radar avoidance.
- Link planning on page 2-12 describes factors to be taken into account when planning links, such as range, path loss and data throughput, and introduces PTP LINKPlanner.
- Wireless specifications on page 4-9 contains specifications of the PTP 600 wireless interface, such as RF bands, channel width, spectrum settings, maximum power and link loss.
- Compliance with safety standards on page 4-51 lists the safety specifications against which the PTP 600 has been tested, and describes how to keep RF exposure within safe limits.
- Compliance with radio regulations on page 4-58 describes how the PTP 600 complies with the radio regulations that are in force in various countries.
- Notifications on page 4-67 contains notifications of compliance with the radio regulations that are in force in various regions.
- Data throughput tables on page 4-74 contains tables and graphs to support calculation of the data rate capacity that can be provided by PTP 600 configurations.

For information on configuring and operating the wireless link, refer to the following:

- Task 6: Configuring wireless and telecoms interfaces on page 6-45 describes how to configure the wireless interface using the installation wizard.
- Comparing actual to predicted performance on page 6-95 describes how to check that a newly installed link is achieving predicted levels of performance.
- Managing performance on page 7-35 describes how to manage the performance of a PTP 600 link.
- Testing the radio link on page 8-11 describes what to do if the radio link is not working, or it is unreliable, or the data throughput rate is too low.

Ethernet bridging

This section describes how the PTP 600 controls Ethernet data, in both the customer and system management networks.

Customer network

Transparent Ethernet service

The PTP 600 Series provides an Ethernet service between the Ethernet port at a local ODU and the Ethernet port at an associated remote ODU. The Ethernet service is based on conventional layer two transparent bridging, and is equivalent to the Ethernet Private Line (EPL) service defined by the Metro Ethernet Forum (MEF).

The service is transparent to untagged frames, standard VLAN frames, priority-tagged frames, provider bridged frames, Q-in-Q frames and provider backbone bridged frames. In each case, the service preserves MAC addresses, VLAN ID, Ethernet priority and Ethernet payload in the forwarded frame. The maximum frame size for bridged frames in the customer network is 2000 octets.

Layer two control protocols

The PTP 600 Series is transparent to layer two control protocols (L2CP) including:

- Spanning tree protocol (STP), rapid spanning tree protocol (RSTP)
- Multiple spanning tree protocol (MSTP)
- Link aggregation control protocol (LACP)
- Link OAM, IEEE 802.3ah
- Port authentication, IEEE 802.1X
- Ethernet local management interface (E-LMI), ITU-T Q.933.
- Link layer discovery protocol (LLDP)
- Multiple registration protocol (MRP)
- Generic attribute registration protocol (GARP)

The PTP 600 Series does not generate or respond to any L2CP traffic.

Quality of service for bridged Ethernet traffic

The PTP 600 Series supports eight traffic queues for Ethernet frames waiting for transmission over the wireless link. Ethernet frames are classified by inspection of the Ethernet destination address, the Ethernet priority code point in the outermost VLAN tag, the Differentiated Services Code Point (DSCP) in an IPv4 or IPv6 header, or the Traffic Class in an MPLS header.

PTP 600 provides a configurable mapping between Ethernet, IP or MPLS priority and transmission queue, together with a simple way to restore a default mapping based on the recommended default in IEEE 802.1Q-2005. Untagged frames, or frames with an unknown network layer protocol, can be separately classified.

Scheduling for transmission over the wireless link is by strict priority. In other words, a frame at the head of a given queue is transmitted only when all higher priority queues are empty.

Fragmentation

The PTP 600 Series minimizes latency and jitter for high-priority Ethernet traffic by fragmenting Ethernet frames before transmission over the wireless link. The fragment size is selected automatically according to channel bandwidth and modulation mode of the wireless link. Fragments are reassembled on reception, and incomplete Ethernet frames are discarded.

Lowest Ethernet Modulation Mode

The PTP 600 ODU can be configured to discard Ethernet frames when the modulation mode is lower than the configured Lowest Ethernet Modulation Mode.

This feature is likely to be useful in networks that have alternate routes, for example in a ring or mesh topology where EAPS or RSTP is used to resolve loops. In this application, Lowest Ethernet Modulation Mode should be set to ensure that an active link will provide at least the minimum necessary capacity for high-priority constant bit rate traffic such as voice over IP or TDM pseudo wire. An active link will be blocked when the capacity falls below the minimum required, triggering a routing change in associated Ethernet switches to bring alternate links into use.

Lowest Ethernet Modulation Mode should normally be set to BPSK 0.63 Single in simply connected tree networks or other topologies that do not have alternative routes.

Management network

IP interface

The PTP 600 ODU contains an embedded management agent with a single IP interface. Network management communication is exclusively based on IP and associated higher layer transport and application protocols. The default IP address of the management agent is 169.254.1.2 in the master ODU and 169.254.1.1 in the slave ODU. The PTP 600 does not require use of supplementary serial interfaces.

MAC address

The management agent end-station MAC address is recorded on the enclosure. The MAC address is not configurable by the user.

VLAN membership

The management agent can be configured to transmit and receive either untagged, priority-tagged, C-tagged (IEEE 802.1Q) or S-tagged (IEEE 802.1ad) frames. S-tagged frames must be single tagged, in other words, an S-tag with no encapsulated C-tag. The VLAN ID can be 0 (priority tagged) or in the range 1 to 4094.

In-band management

In the in-band management mode, the management agent can be reached from the PIDU+ port at the local ODU, and (assuming that the wireless link is established) the PIDU+ port at the remote ODU.

Management frames in the customer network are processed by the management agent if (a) destination MAC address in the frame matches the ODU MAC address, and (b) the VLAN ID in the frame matches the VLAN configuration of the management agent.

If Local Packet Filtering is enabled, unicast frames forwarded to the management agent are filtered, that is, not forwarded in the customer network.

In-band quality of service

Frames generated within the management agent may be assigned a configured Ethernet priority. Management frames are multiplexed with customer frames of the same priority for transmission at the wireless port.

In-band local management

In the in-band local management mode, the management agent can be reached from the PIDU+ port at the local ODU, but not from the PIDU+ port at the remote ODU.

Management frames in the customer network are processed by the management agent if (a) destination MAC address in the frame matches the ODU MAC address, and (b) the VLAN ID in the frame matches the VLAN configuration of the management agent. All Ethernet frames in the management VLAN (regardless of destination address) are filtered (discarded) at the wireless port.

In-band local management mode is useful in networks that require only local access for network management. For correct operation of in-band local management mode, ensure that the same management VLAN ID is configured at both ends of the link.

Out-of-band management

PTP 600 supports an end-to-end out-of-band management mode in which the management agent can be reached from the AUX port at the local ODU, and (assuming that the wireless link is established) the AUX port at the remote ODU. This management mode allows communication from the ODU management port to Ethernet end stations reached through the remote ODU, supporting construction of an extended management network that is isolated from the customer network.

The capacity of the out-of-band management network is approximately 500 kbit/s in each direction.

End-to-end out-of-band management is possible only when the network management mode is configured to “out-of-band” at every ODU.

Out-of-band management is only available in the following product variants:

- PTP 45600
- PTP 54600 OOBM
- PTP 58600 OOBM

Out-of-band quality of service

Out-of-band management traffic is forwarded over the wireless link using a dedicated channel. The management channel represents a single traffic class, and the same quality of service is afforded to all management frames. Traffic in the management channel is fragmented for transmission over the wireless link to minimize the jitter imposed on high priority traffic in the customer network.

The management channel has higher priority than traffic in the customer network.

Out-of-band local management

The out-of-band local management mode is similar to the standard out-of-band mode, except that management frames are not forwarded over the wireless link. Connection to the management agent is solely through the management port of the local ODU.

Source address learning

If Local Packet Filtering is enabled, the PTP 600 learns the location of end stations from the source addresses in received management frames. The agent filters transmitted management frames to ensure that the frame is transmitted at the Ethernet port, or over the wireless link as appropriate. If the end station address is unknown, then management traffic is transmitted at the Ethernet port and over the wireless link.

Wireless link down alert

The PTP 600 Series provides an optional indication of failure of the wireless link by means of a brief disconnection of the copper data port or the fiber data port. The Wireless link down alert can be used to trigger protection switching by Spanning Tree Protocol (STP) or Ethernet Automatic Protection Switching (EAPS) in a redundant network.

Back-to-back links

PTP 600 will not operate correctly if a direct cabled copper connection is made between two PIDUs. Where two or more links are deployed in a chain, use one of the following solutions:

- Copper or fiber connections between the PIDU and a suitable Ethernet switch or router.
- A fiber connection between two ODUs, with the 'Ethernet Media Type to Use' control set to 'Fiber Media Only'. For more information, refer to the *PTP 600 Series Optical Interface Upgrade Guide*.

Protocol model

Ethernet bridging behavior at each end of the wireless link is equivalent to a two-port, managed, transparent MAC bridge where the two ports are:

- Ethernet Port
- Wireless Port

Frames are transmitted at the Wireless port over a proprietary point-to-point circuit-mode link layer between ends of the PTP 600 link. Ethernet frames received at the Ethernet port, or generated internally within the management agent, are encapsulated within a lightweight MAC layer for transmission over the wireless link.

In out-of-band local mode (Figure 18) and out-of-band mode (Figure 19), the management network (shown in red) is isolated from the customer data network (shown in blue). In out-of-band mode, the management network is isolated from the customer data at the wireless port by use of a separate service access point and associated dedicated logical channel. Ethernet frames will not leak between management and data networks, even in the presence of configuration errors.

Figure 18 Forwarding behavior in out-of-band local management mode

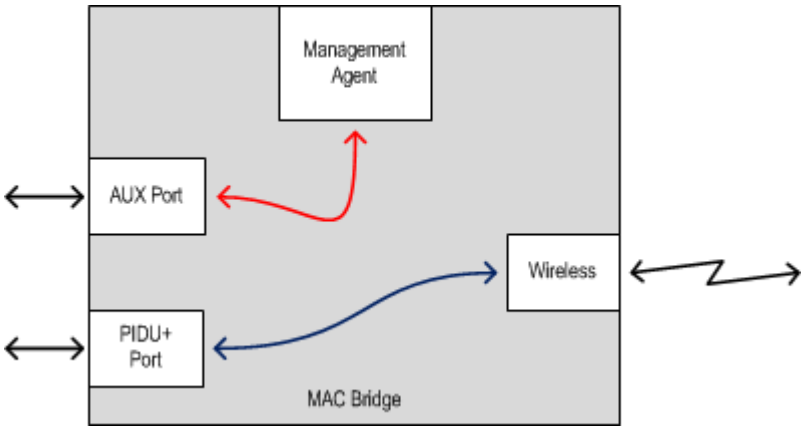
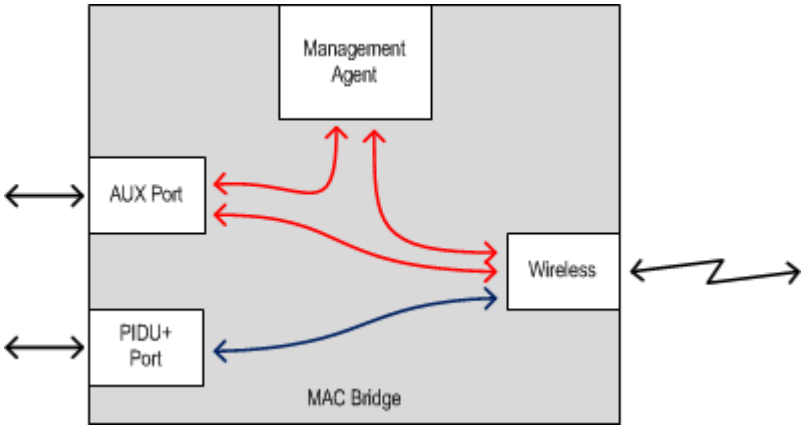


Figure 19 Forwarding behavior in out-of-band management mode



Protocol layers involved in bridging between Ethernet and wireless interfaces are shown in Figure 20. Protocol layers involved in bridging between external interfaces and the management agent are shown in Figure 21. In these figures, the layers have the meanings defined in IEEE 802.1Q-2005.

Figure 20 Protocol layers between Ethernet and wireless interfaces

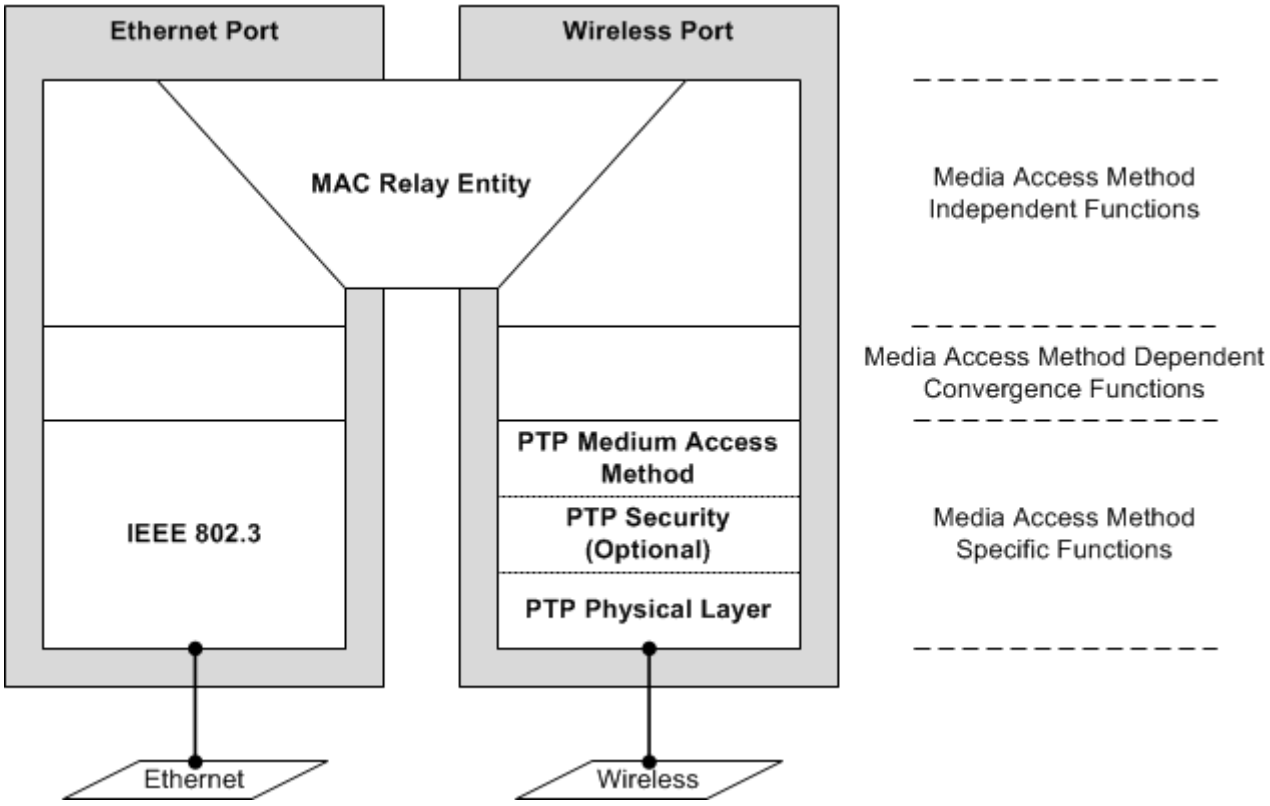
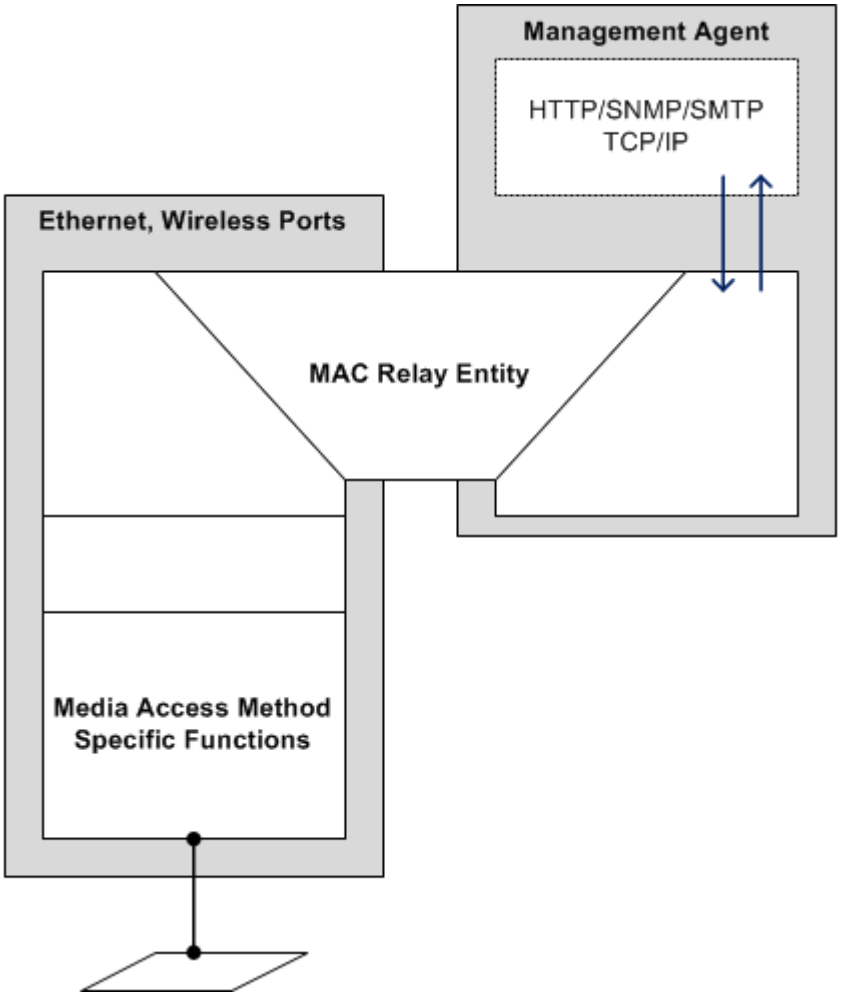


Figure 21 Protocol layers between external interfaces and the management agent



Further reading on Ethernet bridging

For more information on Ethernet bridging, refer to the following:

- Data network planning on page 2-37 describes factors to be considered when planning PTP 600 data networks.
- Data network specifications on page 4-46 contains specifications of the PTP 600 Ethernet interface.
- Task 6: Configuring wireless and telecoms interfaces on page 6-45 describes how to configure the IP and Ethernet attributes of the PTP 600.
- Reviewing system configuration attributes on page 6-92 describes how to review the IP and Ethernet attributes of the PTP 600.

Telecoms circuits

This section describes how telecoms traffic (E1 or T1) may be carried over PTP 600 links.

The PTP 600 link provides native support for one or two E1 links, or one or two T1 links. The link relays unstructured E1 or T1 data and provides accurate timing transfer.

Lowest telecoms modulation mode

In narrow channel bandwidth and lower modulation modes, the link may have insufficient capacity to relay the E1/T1 payload; in this case, the wireless link continues to carry timing information in order to maintain accurate clock synchronization. The relay of telecoms data resumes automatically when the link reaches a suitable modulation mode.

Links that are able to operate consistently in a high modulation mode can take advantage of lower link latency. This option is configured by setting the "Lowest Telecoms Modulation Mode" during installation. Appropriate settings for this control may be determined by using the PTP LINKPlanner tool. The reduction in latency is achieved by disabling the relay of telecoms data in lower modulation modes, and this necessarily results in somewhat lower availability for the telecoms circuit. The loss of availability can be estimated using the Link Planner.

The unit will override the user setting of Lowest Telecoms Modulation Mode if the selected mode has insufficient capacity to carry the telecoms data, or if the mode demands very high latency and requires more buffering than the link can provide. When the effective mode differs for Single and Dual Payload operation two modes will be displayed: "Lowest Dual Payload Modulation Mode" and "Lowest Single Payload Modulation Mode".

Fixed frequency operation

In the PTP 600 link, data errors may occur during channel changes on an operational link. It may be appropriate to minimize channel-change-related errors in a link carrying Telecoms traffic by preventing channel changes initiated by i-DFS. This can be achieved by barring all channels except one in the Spectrum Management page, or alternately by selecting Fixed Frequency mode. These steps unavoidably disable interference avoidance mechanisms, and should not be taken if the risk of errors due to interference is more severe than the risk due to channel changes.

Fixed frequency operation is not available when radar detection requirements exist in the frequency band. Channel barring is allowed in radar regions, but it is unwise to bar all channels except one, as any radar signals detected on that channel will drop the link for up to 30 minutes.

Further reading on telecoms circuits

For more information on telecoms circuits, refer to the following:

- Installing an E1 or T1 interface on page 5-50 describes how to install the hardware for an E1 or T1 interface.
- Task 6: Configuring wireless and telecoms interfaces on page 6-45 describes how to configure the telecoms interfaces using the installation wizard.
- Performing a telecoms loopback test on page 8-16 describes how to test and E1 or T1 link when a fault is suspected.

System management

This section introduces the PTP 600 management system, including the web interface, installation, configuration, alerts and upgrades.

Management agent

PTP 600 equipment is managed through an embedded management agent. Management workstations, network management systems or PCs can be connected to this agent using a choice of two in-band and two out-of-band modes. These modes are described in detail in Management network on page 1-40.

The management agent supports the following interfaces:

- Hyper text transfer protocol (HTTP)
- HTTP over transport layer security (HTTPS/TLS)
- RADIUS authentication
- TELNET
- Simple network management protocol (SNMP)
- Simple mail transfer protocol (SMTP)
- Simple network time protocol (SNTP)
- System logging (syslog)

Web server

The PTP 600 management agent contains a web server. The web server supports the HTTP and HTTPS/TLS interfaces.

Operation of HTTPS/TLS is enabled by purchase of an optional AES upgrade as described in Task 3: Installing license keys on page 6-14.

Web-based management offers a convenient way to manage the PTP 600 equipment from a locally connected computer or from a network management workstation connected through a management network, without requiring any special management software. The web-based interfaces are the only interfaces supported for installation of PTP 600, and for the majority of PTP 600 configuration management tasks.

Web pages

The web-based management interfaces provide comprehensive web-based fault, configuration, performance and security management functions organized into the following web-pages and groups:

- **Home:** The Home web-page reports Wireless Link Status and basic information needed to identify the link. The Home page additionally lists all active alarm conditions
- **Status:** The Status web-page reports the detailed status of the PTP 600.
- **System:** These web-pages are used for configuration management, including IP and Ethernet, AES encryption keys, quality of service, software upgrade and installation of license keys. The System pages additionally provide detailed counters and diagnostic measurements used for performance management.
- **Installation:** The Installation Wizard is used to configure the PTP 600 wireless interface and to arm the unit ready for alignment.
- **Management:** These web-pages are used to configure the network management interfaces.
- **Security:** The Security Wizard is used to configure the HTTPS/TLS interface, and to operate the PTP 600 with optional enhanced security for FIPS 140-2 or UC APL applications. The Security Wizard is disabled until AES encryption is enabled by license key.
- **Change Password**: The Change Password web-page changes the web-interface password of the active user. Users use this screen to change their own password.
- **Logout:** Allows a user to log out from the web-based interface.

Transport layer security

The HTTPS/TLS interface provides the same set of web-pages as the HTTP interface, but allows HTTP traffic to be encrypted using Transport Layer Security (TLS). PTP 600 uses AES encryption for HTTPS/TLS. Operation of HTTPS/TLS is enabled by purchase of an optional AES upgrade as described in Task 3: Installing license keys on page 6-14.

HTTPS/TLS requires installation of a private key and a public key certificate where the common name of the subject in the public key certificate is the IP address or host name of the PTP 600 unit. PTP 600 supports certificates with 1024-bit and 2048-bit key size.

HTTPS/TLS operation is configured through the web-based interfaces using the Security Wizard.

Details of the security material needed for HTTPS/TLS are provided in Security planning on page 2-41.

NOTE

The PTP 600 has no default public key certificate, and Cambium is not able to generate private keys or public key certificates for specific network applications.

User account management

PTP 600 allows a network operator to configure a policy for login attempts, the period of validity of passwords and the action taken on expiry of passwords. See Configuring local user accounts on page 6-34 for further details.

Identity-based user accounts

The PTP 600 web-based interface provides two methods of authenticating users:

- Role-based user authentication allows the user, on entry of a valid password, to access all configuration capabilities and controls. This is the default method.
- Identity-based user authentication supports up to 10 users with individual usernames and passwords.

When identity-based user accounts are enabled, a security officer can define from one to ten user accounts, each of which may have one of the three possible roles:

- Security officer.
- System administrator.
- Read only.

Identity-based user accounts are enabled in the Local User Accounts page of the web-based interface.

Password complexity

PTP 600 allows a network operator to enforce a configurable policy for password complexity. Password complexity configuration additionally allows a pre-determined best practice configuration to be set. See Configuring local user accounts on page 6-34 for further details.

RADIUS authentication

PTP 600 supports remote authentication for users of the web interface using the Remote Authentication Dial-In User Service (RADIUS) with one of the following authentication methods:

- Challenge Handshake Authentication Protocol (CHAP)
- Microsoft CHAP Version 2 (MS-CHAPv2)
- MS-CHAPv2 with Protected EAP.

Operation of Protected EAP is enabled by purchase of an optional AES upgrade as described in Task 3: Installing license keys on page 6-14.

PTP 600 supports connections to primary and secondary RADIUS servers. The RADIUS interface is configured through the RADIUS Authentication page of the web-based interfaces.

PTP 600 RADIUS supports the standard Service Type attribute to indicate authentication roles of System Administrator and Read Only together with a vendor specific attribute to indicate authentication roles of Security Officer, System Administrator, and Read Only.

Remote authentication can be used in addition to local authentication, or can be used as a replacement for local authentication. If remote and local authentications are used together, PTP 600 checks log in attempts against locally stored user credentials before submitting a challenge and response for remote authentication. Remote authentication is not attempted if the username and password match locally stored credentials.

RADIUS is only available when PTP 600 is configured for Identity-based User Accounts. For more information, refer to Planning for RADIUS operation on page 2-50.

PTP 600 supports Protected EAP with Microsoft Windows Server 2003.

SNMP

The management agent supports fault and performance management by means of an SNMP interface. The management agent is compatible with SNMP v1, SNMP v2c, and SNMPv3 using the following Management Information Bases (MIBs):

- RFC-1493. BRIDGE-MIB. dot1dBase group.
- RFC-2233. IF-MIB. Interfaces group, and ifXTable table.
- RFC-3411. SNMP-FRAMEWORK-MIB. snmpEngine group.
- RFC-3412. SNMP-MPD-MIB. snmpMPDStats group.
- RFC-3413. SNMP-TARGET-MIB. snmpTargetObjects group and SNMP-NOTIFICATION-MIB snmpNotifyTable table.
- RFC-3414. SNMP-USER-BASED-SM-MIB. usmStats group and usmUser group.
- RFC-3415. SNMP-VIEW-BASED-ACM-MIB vacmMIBObjects group.
- RFC-3418. SNMPv2-MIB. System group, SNMP group, and set group.
- RFC-3826. SNMP-USM-AES-MIB. usmAesCfb128Protocol OID.
- PTP 600 Series proprietary MIB.

Simple Network Time Protocol (SNTP)

The clock supplies accurate date and time information to the system. It can be set to run with or without a connection to a network time server (SNTP). It can be configured to display local time by setting the time zone and daylight saving in the Time web page.

If an SNTP server connection is available, the clock can be set to synchronize with the server time at regular intervals. For secure applications, the PTP 600 can be configured to authenticate received NTP messages using the DES protocol.

SNMPv3 security

SNMP Engine ID

PTP 600 supports three different formats for SNMP Engine ID:

- MAC address
- IP address
- Configurable text string

SNMPv3 security configuration is re-initialized when the SNMP Engine ID is changed.

User-based security model

PTP 600 supports the SNMPv3 user-based security model (USM) for up to 10 users, with MD5, SHA-1, DES and (subject to the license key) AES protocols in the following combinations:

- No authentication, no privacy,
- MD5, no privacy,
- SHA-1, no privacy,
- MD5, DES,
- SHA-1, DES,
- MD5, AES,
- SHA-1, AES.

Use of AES privacy requires the PTP 600 AES upgrade described in AES license on page 1-56. The ODU will allow the creation of users configured with AES privacy protocol, regardless of license key. However, a user configured to use AES privacy protocol will not be able to transmit and receive encrypted messages unless the license key enables the AES capability.

View-based access control model

PTP 600 supports the SNMPv3 view-based access control model (VACM) with a single context. The context name is the empty string. The context table is read-only, and cannot be modified by users.

Access to critical security parameters

The SNMPv3 management interface does not provide access to critical security parameters (CSPs) of PTP 600. It is not possible to read or modify AES keys used to encrypt data transmitted at the wireless interface. Neither is it possible to read or modify security parameters associated with TLS protection of the web-based management interface. The recovery mode option to zeroize CSPs does not affect SNMPv3 configuration.

MIB-based management of SNMPv3 security

PTP 600 supports a standards-based approach to configuring SNMPv3 users and views through the SNMP MIB. This approach provides maximum flexibility in terms of defining views and security levels appropriate for different types of user.

PTP 600 provides a default SNMPv3 configuration. This initial configuration is not secure, but it provides the means by which a secure configuration can be created using SNMPv3.

The secure configuration should be configured in a controlled environment to prevent disclosure of the initial security keys necessarily sent as plaintext, or sent as encrypted data using a predictable key. The initial security information should not be configured over an insecure network.

The default configuration is restored when any of the following occurs:

- All ODU configuration data is erased.
- All SNMP users are deleted using the SNMP management interface.
- The SNMP Engine ID Format has been changed.
- The SNMP Engine ID Format is IP Address AND the IP Address has been changed.
- The SNMP Engine ID Format is Text String AND the text string has been changed.
- The SNMP Engine ID Format is MAC Address AND configuration has been restored using a file saved from a different unit.
- SNMPv3 Security Management is changed from web-based to MIB-based.

The default user configuration is specified in SNMPv3 default configuration (MIB-based) on page 2-49.

PTP 600 creates the `initial` user and template users with localized authentication and privacy keys derived from the passphrase string `123456789`. Authentication keys for the templates users are fixed and cannot be changed. Any or all of the template users can be deleted.

The default user `initial` is created with a view of the entire MIB, requiring authentication for SET operations. There is no access for template users.

> **NOTE**
> VACM grants access for requests sent with more than the configured security level.

The default user `initial` will have read/write access to the whole of the MIB. This is described in further detail in View-based access control model on page 1-53. The template users have no access to the MIB in the default configuration. User `initial` will normally be used to create one or more additional users with secret authentication and privacy keys, and with appropriate access to the whole of the MIB or to particular views of the MIB according to the operator's security policy. New users must be created by cloning template users. The user `initial` may then be deleted to prevent access using the well-known user name and keys. Alternatively, the keys associated with `initial` may be set to some new secret value.

Web-based management of SNMPv3 security

PTP 600 supports an alternative, web-based approach for configuring SNMPv3 security. In this case, the web-based interface allows users to specify SNMPv3 users, security levels, privacy and authentication protocols, and passphrases. Web-based management will be effective for many network applications, but the capabilities supported are somewhat less flexible than those supported using the MIB-based security management.

Selection of web-based management for SNMPv3 security disables the MIB-based security management.

Web-based management of SNMPv3 security allows for two security roles:

- Read Only
- System Administrator

'Read Only' and 'System Administrator' users are associated with fixed views allowing access to the whole of the MIB, excluding the objects associated with SNMPv3 security. System Administrators have read/write access as defined in the standard and proprietary MIBs.

Web-based management of SNMPv3 security allows an operator to define the security levels and protocols for each of the security roles; all users with the same role share a common selection of security level and protocols.

Web-based security configuration is re-initialized when any of the following occurs:

- All ODU configuration data is erased.
- The SNMP Engine ID Format has been changed.
- The SNMP Engine ID Format is IP Address and the IP Address has been changed.
- The SNMP Engine ID Format is Text String and the text string has been changed.

- The SNMP Engine ID Format is MAC Address and configuration has been restored using a file saved from a different unit.
- SNMPv3 Security Management is changed from MIB-based to web-based.

Additionally, all SNMP user accounts are disabled when the authentication protocol, the privacy protocol, or the security level is changed.

Downgrade of the license key

A possible lockout condition exists if a user downgrades the PTP 600 license key so as to disable the AES capability when SNMPv3 users are configured with AES privacy and VACM is configured to require privacy. In this case, recovery is by either (a) restoring the correct license key, or (b) using recovery mode to erase all configuration and entering new configuration.

Option (b) will cause default users and access configuration to be re-created.

System logging (syslog)

PTP 600 supports the standard syslog protocol to log important configuration changes, status changes and events. The protocol complies with RFC 3164.

PTP 600 creates syslog messages for configuration changes to any attribute that is accessible via the web-based interface, or via the enterprise MIB at the SNMP interface.

PTP 600 additionally creates syslog messages for changes in any status variable displayed in the web-based interface.

PTP 600 creates syslog messages on a number of events (for example successful and unsuccessful attempts to log in to the web-based interface).

PTP 600 can be configured to send syslog messages to one or two standard syslog servers.

Additionally, PTP 600 logs event notification messages locally. Locally-stored event messages survive reboot of the unit, and are overwritten only when the storage capacity is exhausted (approximately 2000 messages). The locally stored events can be reviewed using the web-based user interface.

Only users with ‘Security Officer’ role are permitted to configure the syslog client. Users with Security Officer, System Administrator or Read Only roles are permitted to review the locally logged event messages.

AES license

PTP 600 provides optional encryption using the Advanced Encryption Standard (AES). Encryption is not available in the standard PTP 600 system.

AES upgrades are supplied as an access key purchased from your Cambium Point-to-Point distributor or solutions provider. The access key authorizes AES operation for one ODU. Two access keys are needed to operate AES on a link. The upgrade is applied by entering an access key together with the MAC address of the target ODU into the PTP License Key Generator web page, which may be accessed from the support website (see Contacting Cambium Networks on page 2).

The License Key Generator creates a new license key that is delivered by email. The license key must be installed on the ODU. When the license key is installed, the ODU must be rebooted before AES can be enabled. Once applied, the AES upgrade is bound to a single ODU and is not transferrable.

AES encryption may be used in the following ways:

- At the wireless port to encrypt data transmitted over the wireless link.
- At the SNMP management interface in the SNMPv3 mode.
- At the HTTPS/TLS management interface.
- At the RADIUS interface when PEAP (MS-CHAPv2) is used as the authentication method.

Two levels of encryption are available to purchase:

- 128-bit: This allows an operator to encrypt all traffic sent over the wireless link using 128-bit encryption.
- 256-bit: This allows an operator to encrypt traffic using either 128-bit or 256-bit encryption.

Encryption must be configured with the same size key in each direction.

AES encryption at the PTP 600 wireless port is based on pre-shared keys. An identical key must be entered at each end of the link.

AES encryption for SNMPv3 or TLS is always based on a 128-bit key, regardless of level enabled in the PTP 600 license key.

For more information, see:

- Task 3: Installing license keys on page 6-14
- Task 5: Configuring security on page 6-21

Critical security parameters

Critical security parameters (CSPs) are as follows:

- Key of keys.
- AES encryption keys for the wireless interface.
- Private key for the HTTPS/TLS interface.
- Entropy value for the HTTPS/TLS interface.
- User account passwords for the web-based interface.

CSPs can be erased (zeroized) using the Zeroize CSPs page of the web-based interface or by selecting the Zeroize CSPs option in Recovery mode.

Login information

PTP 600 optionally provides details of the most recent successful login, and the most recent unsuccessful login attempt, for each user of the web-based interface.

Capacity upgrades

Capacity upgrades are supplied as an access key purchased from your Cambium Point-to-Point distributor or solutions provider. The upgrade is applied by entering an access key together with the MAC address of the target ODU into the PTP License Key Generator web page, which may be accessed from the support website (see Contacting Cambium Networks on page 2).

The License Key Generator creates a new license key delivered by email. The license key must be installed on the ODU as described in reference to Task 3: Installing license keys on page 6-14. Once applied, the capacity upgrade is bound to a single ODU and is not transferrable.

Software upgrade

The management agent supports application software upgrade using either the web-based interface or the SNMP interface.

PTP 600 software images are digitally signed, and the ODU will accept only images that contain a valid Cambium PTP digital signature. The ODU always requires a reboot to complete a software upgrade.

NOTE

Obtain the application software and this user guide from the support website BEFORE warranty expires.

CAUTION

ODU software version must be the same at both ends of the link. Limited operation may sometimes be possible with dissimilar software versions, but such operation is not supported by Cambium.

The management process for software upgrade is described in detail in Task 4: Upgrading software version on page 6-17.

Software can be downgraded using Recovery mode as described in Recovery mode on page 1-58.

Recovery mode

The PTP 600 recovery mode provides a means to recover from serious configuration errors including lost or forgotten passwords and unknown IP addresses.

Recovery mode also allows new main application software to be loaded even when the integrity of the existing main application software image has been compromised. The most likely cause of an integrity problem with the installed main application software is where the power supply has been interrupted during an earlier software upgrade.

The ODU operates in recovery mode in the following circumstances:

- When a checksum error occurs for the main application software image.
- When the PIDU recovery button is pressed at the same time as the ODU is rebooted or power cycled.

Recovery mode options

Options in recovery mode are as follows:

- Load new main application software.
- Reset all configuration data to factory default. This option resets IP and Ethernet configuration, and erases (zeroizes) critical security parameters.
- Reset IP and Ethernet configuration to factory default.
- Erase (zeroize) critical security parameters.
- Reboot with existing software and configuration.

NOTE

If recovery mode has been entered because of a checksum error, by default the ODU will reboot with existing software and configuration, following a 30 second wait.

The recovery software image is installed during manufacture of the ODU and cannot be upgraded by operators.

For detailed instructions on using the recovery mode, see Using recovery mode on page 7-53.

Further reading on system management

For more information on system management, refer to the following:

- Security planning on page 2-41 describes how to plan for PTP 600 links to operate in secure modes, including SNMP and SNMPv3.
- Chapter 6: Configuration and alignment describes all configuration and alignment tasks that are performed when a PTP 600 link is deployed.
- Chapter 7: Operation provides instructions for operators of the PTP 600 web user interface.

FIPS 140-2 mode

This section describes the (optional) FIPS 140-2 cryptographic mode of operation.

PTP 600 provides an optional secure cryptographic mode of operation validated to Level 2 of Federal Information Processing Standards Publication 140-2.

FIPS 140-2 capability

A PTP 600 unit is capable of operating in the FIPS 140-2 mode when all of the following are true:

- The hardware security of the ODU is compatible with operation in the FIPS 140-2 mode.
- The ODU license key has AES encryption enabled.
- The ODU license key has FIPS operation enabled.
- The ODU software image is validated for FIPS operation.

Hardware security

The ODU has compatible hardware security if the part number suffix on the external packaging is no earlier than the minimum listed in Table 7.

Table 7 Minimum part number suffix for FIPS 140-2 mode

Frequency variant	Part number suffix
PTP 25600	BB
PTP 45600	BB
PTP 48600	AA
PTP 49600	AA
PTP 54600	EE
PTP 58600	DD
PTP 59600	BB

The ODU will also have compatible hardware security if the part number suffix is earlier and PTP 600 Hardware Security Upgrade has been applied. The Hardware Security Upgrade Kit is available as Cambium part number WB3593AA.

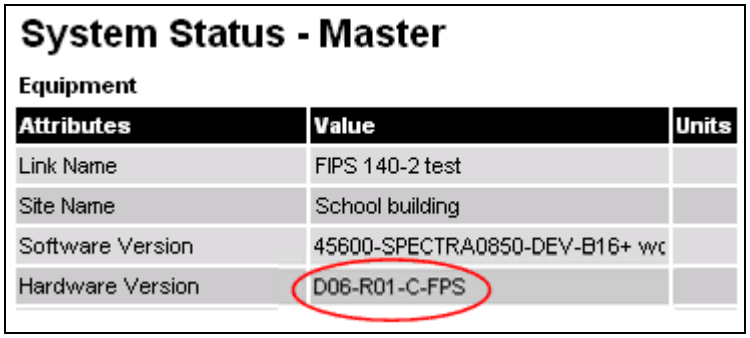
Units with compatible hardware security have tamper-evident labels fitted as shown in Figure 22 and Figure 23.

Figure 22 Tamper evident label on side edge of ODU

Figure 23 Tamper evident label on top edge of ODU

The ODU will have hardware security compatible with FIPS 140-2 if the hardware version displayed on the Status page contains the string 'FPS', as shown in Figure 24. This provides an alternative means of checking hardware where the ODU has already been deployed, and is in a physical location that makes it difficult to observe tamper-evident labels.

Figure 24 FIPS 140-2 hardware version identification



Validated software image

FIPS validated software images are indicated by a `FIPS-` prefix to the file name, for example: `FIPS-PTP600-09-01.DLD2`. The general features of a FIPS validated software image are identical to those of the standard image with the same version number. For example, `FIPS-PTP600-09-01.DLD2` is equivalent to `PTP600-09-01.DLD2` apart from the ability of the FIPS image to operate in FIPS mode.

Indication of FIPS 140-2 capability

The FIPS 140-2 capability is indicated by a distinctive symbol displayed at the top of the navigation bar in the web-based interface, as shown in Figure 25.

Figure 25 Indication of FIPS 140-2 capability

FIPS 140-2 mode

PTP 600 operates in the FIPS 140-2 mode when all of the following are true:

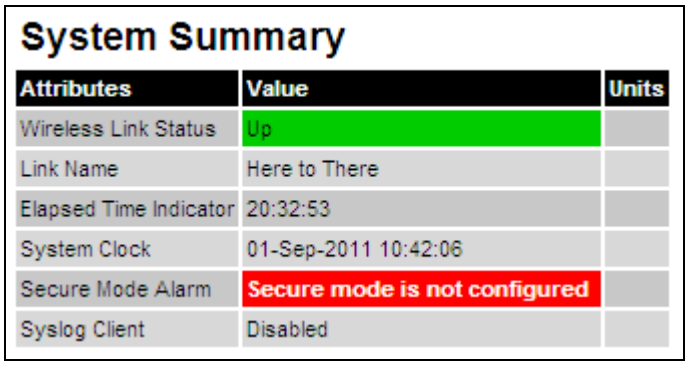
- The PTP 600 is FIPS 140-2 capable.
- The HTTPS/TLS management interface is enabled.
- The HTTP management interface is disabled.
- AES encryption is enabled at the wireless interface.
- RADIUS authentication of web-based users is disabled.

The Telnet management interface is automatically disabled in FIPS 140-2 mode. SNMP control of HTTP and Telnet is automatically disabled in FIPS 140-2 mode. Identity-Based User Accounts are automatically enabled in FIPS 140-2 mode.

Secure mode alarm

The secure mode alarm indicates that the unit is FIPS 140-2 capable, but has not been configured correctly for FIPS 140-2 operation. The secure mode alarm appears as shown in Figure 26.

Figure 26 Secure mode alarm



Indication of FIPS 140-2 mode

The PTP 600 is operating in FIPS 140-2 mode when the FIPS 140-2 capability logo is displayed in the navigation bar and the secure mode alarm is absent from the Home page.

Exiting from the FIPS 140-2 operational mode

A PTP 600 ODU in FIPS 140-2 operational mode can be prepared to accept new security configuration by zeroizing critical security parameters (CSPs). The unit remains FIPS 140-2 capable.

Reverting to standard operation

A FIPS 140-2 capable ODU can be used in standard (non-FIPS) mode by loading a standard (non-FIPS) software image and rebooting.

The critical security parameters (CSPs) are zeroized when the unit is no longer FIPS 140-2 capable.

Further reading on FIPS 140-2

For more information on FIPS 140-2, refer to the following:

- Planning for FIPS 140-2 operation on page 2-42 describes how to prepare for FIPS 140-2 operation by obtaining the required cryptographic material and by configuring the PTP 600 system.
- Configuring for FIPS 140-2 applications on page 6-111 is a summary of all the configuration tasks that are necessary if the unit is to operate in FIPS 140-2 secure mode.
- Task 3: Installing license keys on page 6-14 describes how to ensure that FIPS 140-2 operation is enabled by license key.

- Task 4: Upgrading software version on page 6-17 describes how to ensure that the installed software version is FIPS 140-2 validated.
- Task 5: Configuring security on page 6-21 describes how to configure the PTP 600 in accordance with the network operator's security policy.
- Exiting FIPS 140-2 or UC APL mode on page 7-34 describes how to disable FIPS 140-2 operation.

Unified Capabilities Approved Product (UC APL) mode

PTP 600 must be operated in the Unified Capabilities Approved Product List (UC APL) secure mode when it is deployed as part of a Unified Capabilities network.

UC APL capability

A PTP 600 unit is capable of operating in the UC APL mode when all of the following are true:

- The hardware security of the ODU is compatible with operation in the FIPS 140-2 mode.
- The ODU license key has AES encryption enabled.
- The ODU license key has UC APL operation enabled.
- The ODU software image is validated for UC APL operation.

Hardware security

Please refer to Hardware security on page 1-60.

Validated software image

UC APL validated software images are indicated by a `UC_APL-` prefix to the file name, for example: `UC_APL-PTP600-10-00.DLD2`. The general features of a UC APL validated software image are identical to those of the FIPS 140-2 image with the same version number. For example, `UC_APL-PTP600-10-00.DLD2` is equivalent to `PTP600-10-00.DLD2` apart from the ability of the UC APL image to operate in UC APL mode.

Indication of UC APL capability

The UC APL capability is indicated by a distinctive graphic displayed at the top of the navigation bar in the web-based interface, as shown in Figure 27.

Figure 27 Indication of UC APL capability

UC APL mode

PTP 600 operates in the UC APL mode when all of the following are true:

- The PTP 600 is UC APL capable.
- The HTTPS/TLS management interface is enabled.
- The HTTP management interface is disabled.
- AES encryption is enabled at the wireless interface.
- RADIUS authentication of web-based users is enabled with PEAP(MS-CHAPv2) as the selected authentication method.

In the UC APL mode, the Telnet interface is automatically disabled, SNMP control of HTTP and Telnet is automatically disabled, and identity-based user accounts are automatically enabled.

Secure mode alarm

The Secure mode alarm indicates that the unit is UC APL capable, but has not been configured correctly for UC APL operation. The Secure mode alarm appears as shown in Figure 26.

Indication of UC APL mode

The PTP 600 is operating in UC APL mode when the UC APL capability graphic is displayed in the navigation bar and the Secure Mode Alarm is absent from the Home page. Alternatively, navigate to the Summary page of the Security Wizard and check that the Secure Mode Alarm is in the “Secure Mode Is Active” state.

Exiting from the UC APL operational mode

A PTP 600 ODU in UC APL operational mode can be prepared to accept new security configuration by zeroizing critical security parameters (CSPs). The unit remains UC APL capable.

Reverting to standard operation

A UC APL capable ODU can be used in standard mode by loading a standard (non-FIPS and non-UC APL) software image and rebooting.

The critical security parameters (CSPs) are zeroized when the unit is no longer UC APL Capable.

Further reading on UC APL

For more information on UC APL, refer to the following:

- Planning for UC APL operation on page 2-43 describes how to prepare for FIPS 140-2 operation by obtaining the required cryptographic material and by configuring the PTP 600 system.
- Configuring for UC APL applications on page 6-114 is a summary of all the configuration tasks that are necessary if the unit is to operate in UC APL secure mode.
- Task 3: Installing license keys on page 6-14 describes how to ensure that UC APL operation is enabled by license key.
- Task 4: Upgrading software version on page 6-17 describes how to ensure that the installed software version is UC APL validated.
- Task 5: Configuring security on page 6-21 describes how to configure the PTP 600 in accordance with the network operator's security policy.
- Exiting FIPS 140-2 or UC APL mode on page 7-34 describes how to disable UC APL operation.

Chapter 2: Planning considerations

This chapter provides information to help the user to plan a PTP 600 link.

The following topics are described in this chapter:

- Regulatory planning on page 2-2 describes how to plan PTP 600 links to conform to the regulatory restrictions that apply in the country of operation.
- Site planning on page 2-6 describes factors to be considered when choosing sites for the ODU, PIDU and PTP-SYNC unit (if installed).
- Link planning on page 2-12 describes factors to be taken into account when planning links, such as range, path loss and throughput. Introduces the PTP LINKPlanner.
- Planning for connectorized units on page 2-17 describes factors to be taken into account when planning to use connectorized ODUs with external antennas in PTP 600 links.
- Grounding and lightning protection on page 2-21 describes the grounding and lightning protection requirements of a PTP 600 installation.
- Configuration options for TDD synchronization on page 2-30 describes the different TDD synchronization methods that may be implemented.
- Mounting options for the PTP-SYNC GPS receiver on page 2-34 describes the requirements of the (optional) GPS receiver for PTP-SYNC.
- Data network planning on page 2-37 describes factors to be considered when planning PTP 600 data networks.
- Security planning on page 2-41 describes how to plan for PTP 600 links to operate in secure mode.
- Ordering components on page 2-53 describes how to select components for a planned PTP 600 link (as an alternative to PTP LINKPlanner). It specifies Cambium part numbers for PTP 600 components.

Regulatory planning

This section describes how to plan PTP 600 links to conform to the regulatory restrictions that apply in the country of operation.

CAUTION

It is the responsibility of the user to ensure that the PTP product is operated in accordance with local regulatory limits.

NOTE

Contact the applicable radio regulator to find out whether or not registration of the PTP 600 link is required.

Regulatory limits

The local regulator may restrict frequency usage and channel width, and may limit the amount of conducted or radiated transmitter power. For details of these restrictions, refer to Examples of regulatory limits on page 4-60.

Many countries impose EIRP limits (Allowed EIRP) on products operating in the bands used by the PTP 600 Series. For example, in the 5.4 GHz and 5.8 GHz bands, these limits are calculated as follows:

- In the 5.4 GHz band (5470 MHz to 5725 MHz), the EIRP must not exceed the lesser of 30 dBm or (17 + 10 x Log Channel width in MHz) dBm.
- In the 5.8 GHz band (5725 MHz to 5875 MHz), the EIRP must not exceed the lesser of 36 dBm or (23 + 10 x Log Channel width in MHz) dBm.

Some countries (for example the USA) impose conducted power limits on products operating in the 5.8 GHz band.

Conforming to the limits

Ensure the link is configured to conform to local regulatory requirements by installing license keys for the correct region code. In the following situations, the license key does not automatically prevent operation outside the regulations:

- When using connectorized ODUs with external antennas, the regulations may require the maximum transmit power to be reduced. To ensure that regulatory requirements are met for connectorized installations, refer to Calculating maximum power level for connectorized units on page 2-18.

- When installing 5.4 GHz links in the USA, it may be necessary to avoid frequencies used by Terminal Doppler Weather Radar (TDWR) systems. For more information, refer to Avoidance of weather radars (USA only) on page 2-5.

Available spectrum

The available spectrum for operation depends on the region. When configured with the appropriate license key, the unit will only allow operation on those channels which are permitted by the regulations.

> **NOTE**
>
> In Italy, there is a regulation which requires a general authorization of any 5.4 GHz radio link which is used outside the operator's own premises. It is the responsibility of the installer or operator to have the link authorized. Details may be found at:
>
> http://www.sviluppoeconomico.gov.it/index.php?option=com_content&view=article&idmenu=672&idarea1=593&andor=AND&idarea2=1052&id=68433&sectionid=1,16&viewType=1&showMenu=1&showCat=1&idarea3=0&andorcat=AND&partebassaType=0&idareaCalendario1=0&MvediT=1&idarea4=0&showArchiveNewsBotton=0&directionidUser=0
>
> The form to be used for general authorization may be found at:
>
> http://www.sviluppoeconomico.gov.it/images/stories/mise_extra/Allegato%20n19.doc

Certain regulations have allocated certain channels as unavailable for use:

- ETSI has allocated part of the 5.4 GHz band to weather radar.
- UK and some other European countries have allocated part of the 5.8 GHz band to Road Transport and Traffic Telematics (RTTT) systems.

For details of these restrictions, refer to Examples of regulatory limits on page 4-60.

Where regulatory restrictions apply to certain channels, these channels are barred automatically by the use of the correct license key and region code. For example, at 5.8 GHz in the UK and some other European countries, the RTTT band 5795 MHz to 5815 MHz is barred. With the appropriate license key installed for this region, the PTP 600 will not operate on channels within this band.

The number and identity of channels barred by the license key and region code is dependent on the channel bandwidth and channel raster selected.

Barred channels are indicated by a 'No Entry' symbol displayed on the Spectrum Management web page, see Spectrum management in radar avoidance mode on page 7-28.

Channel bandwidth

Select the required channel bandwidth for the link. The selection depends upon the PTP 600 frequency variant and region code, as specified in Examples of regulatory limits on page 4-60.

The wider the channel bandwidth, the greater the capacity. As narrower channel bandwidths take up less spectrum, selecting a narrow channel bandwidth may be a better choice when operating in locations where the spectrum is very busy.

Lite versions of the PTP 600 products do not support a channel bandwidth of 5 MHz.

Both ends of the link must be configured to operate on the same channel bandwidth.

Frequency selection

Regions without mandatory radar detection

In regions that do not mandate DFS, choose ‘i-DFS’ or ‘Fixed Frequency’:

- **Intelligent Dynamic Frequency Selection (i-DFS)**: In this mode, the unit monitors the spectrum looking for the channel with the lowest level of interference. Statistical techniques are used to select the most appropriate transmit and receive channels. The unit can be configured such that it operates in i-DFS mode, but does not operate on selected channels. This allows a frequency plan to be implemented in cases where multiple links are installed in close proximity.
- **Fixed Frequency**: In this mode, the unit must be configured with a single fixed transmit frequency and a single fixed receive frequency. These may set to the same value or to different values. This mode should only be considered in exceptional circumstances, for example where it is known that are no sources of interference on the selected channels.

Regions with mandatory radar detection

The PTP 600 fully conforms to regional regulatory requirements for radar avoidance.

In regions that mandate DFS, the unit first ensures that there is no radar activity on a given channel for a period of 60 seconds before radiating on that channel. Once a channel has been selected for operation, the unit will continually monitor for radar activity on the operating channel. If detected, it will immediately cease radiating and attempt to find a new channel.

In DFS regions, choose ‘DFS’ or ‘DFS with i-DFS’:

- **Dynamic Frequency Selection (DFS)**: Once a channel is selected, the unit will only attempt to find an alternative channel if radar activity has been detected on the operating channel.

- **DFS with i-DFS**: In addition to switching channels on detection of radar, the unit will also switch to a channel which has a significantly lower level of interference than the current channel of operation. Before radiating on the newly selected channel, the unit must again ensure that there is no radar activity on the new channel for a period of 60 seconds. This mode therefore provides the benefit of switching to a channel with lower interference but at the expense of an outage of approximately 60 to 120 seconds. For this reason, the threshold for switching channels is greater than when i-DFS is operating in a non-radar region.

Radar avoidance requirements in the 5.4 GHz band are defined as follows:

- For the EU: in specification EN 301-893 version V1.5.1.
- For the US: in the specification FCC part 15.407 plus the later requirements covered in **Important Regulatory Information** in this User Guide.
- For Canada: in the specification RSS210 Annex 9 (Issue 7).

Radar avoidance at 5.8 GHz is applicable to EU operation (not FCC/IC) and the requirements are defined in EN 302 502.

Avoidance of weather radars (USA only)

To comply with FCC rules (KDB 443999: Interim Plans to Approve UNII Devices Operating in the 5470 - 5725 MHz Band with Radar Detection and DFS Capabilities), units which are installed within 35 km (22 miles) of a Terminal Doppler Weather Radar (TDWR) system (or have a line of sight propagation path to such a system) must be configured to avoid any frequency within +30 MHz or –30 MHz of the frequency of the TDWR device. This requirement applies even if the master is outside the 35 km (22 miles) radius but communicates with outdoor clients which may be within the 35 km (22 miles) radius of the TDWRs.

The requirement for ensuring 30 MHz frequency separation is based on the best information available to date. If interference is not eliminated, a distance limitation based on line-of-sight from TDWR will need to be used. In addition, devices with bandwidths greater than 20 MHz may require greater frequency separation.

When planning a link in the USA, visit http://spectrumbridge.com/udrs/home.aspx, enter the location of the planned link and search for TDWR radars. If a TDWR system is located within 35 km (22 miles) or has line of sight propagation to the PTP device, perform the following tasks:

- Register the installation on http://spectrumbridge.com/udrs/home.aspx.
- Make a list of channel center frequencies that must be barred, that is, those falling within +30 MHz or –30 MHz of the frequency of the TDWR radars.

⚠ CAUTION

To comply with FCC rules, the affected channels must be barred during staging, before the units are allowed to radiate on site, as described in Barring channels on page 6-62.

Site planning

This section describes factors to be taken into account when choosing sites for the ODU, PIDU and PTP-SYNC unit (if installed).

ODU site selection

When selecting a site for the ODU, consider the following factors:

- Height and location to ensure that people are kept away from the antenna; see Calculated distances and power compliance margins on page 4-54.
- Height and location to achieve the best radio path.
- Ability to meet the requirements specified in Grounding and lightning protection on page 2-21.
- Aesthetics and planning permission issues.
- Cable lengths; see Maximum cable lengths on page 2-7.
- The effect of strong winds on the installation; see Wind loading on page 2-9.
- The risk that hazardous gases will be present; see Hazardous locations on page 2-11.

PIDU site selection

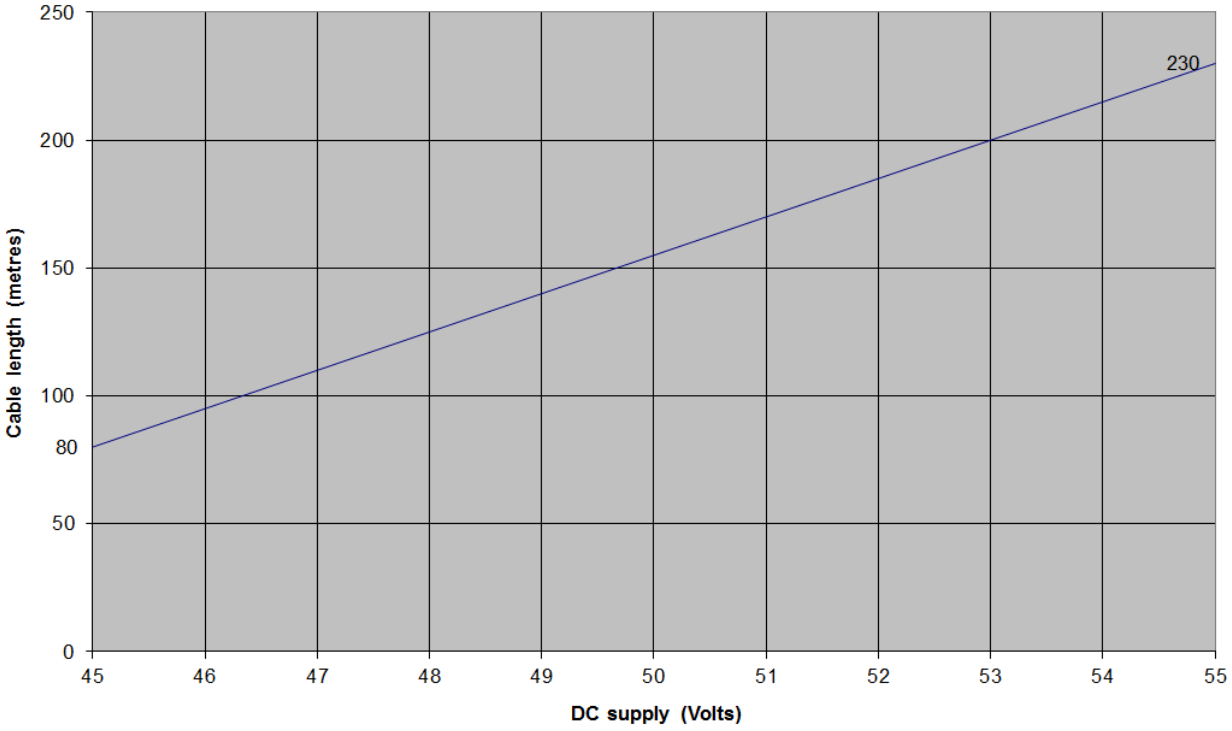
When selecting a site for the PIDU, consider the following factors:

- Indoor location with no possibility of condensation.
- Availability of a mains electricity supply.
- Accessibility for viewing status indicators and pressing Recovery switch.
- Cable lengths; see Maximum cable lengths on page 2-7.

NOTE

The use of DC supplies of less than 55v will reduce the usable distance between the PIDU and ODU (Figure 28).

Figure 28 Relationship between DC voltage and cable length



PTP-SYNC site selection

If PTP-SYNC is to be installed, consider the following factors when selecting a site:

- Indoor location with no possibility of condensation.
- Accessibility for viewing status indicators.
- Cable lengths; see Maximum cable lengths on page 2-7.

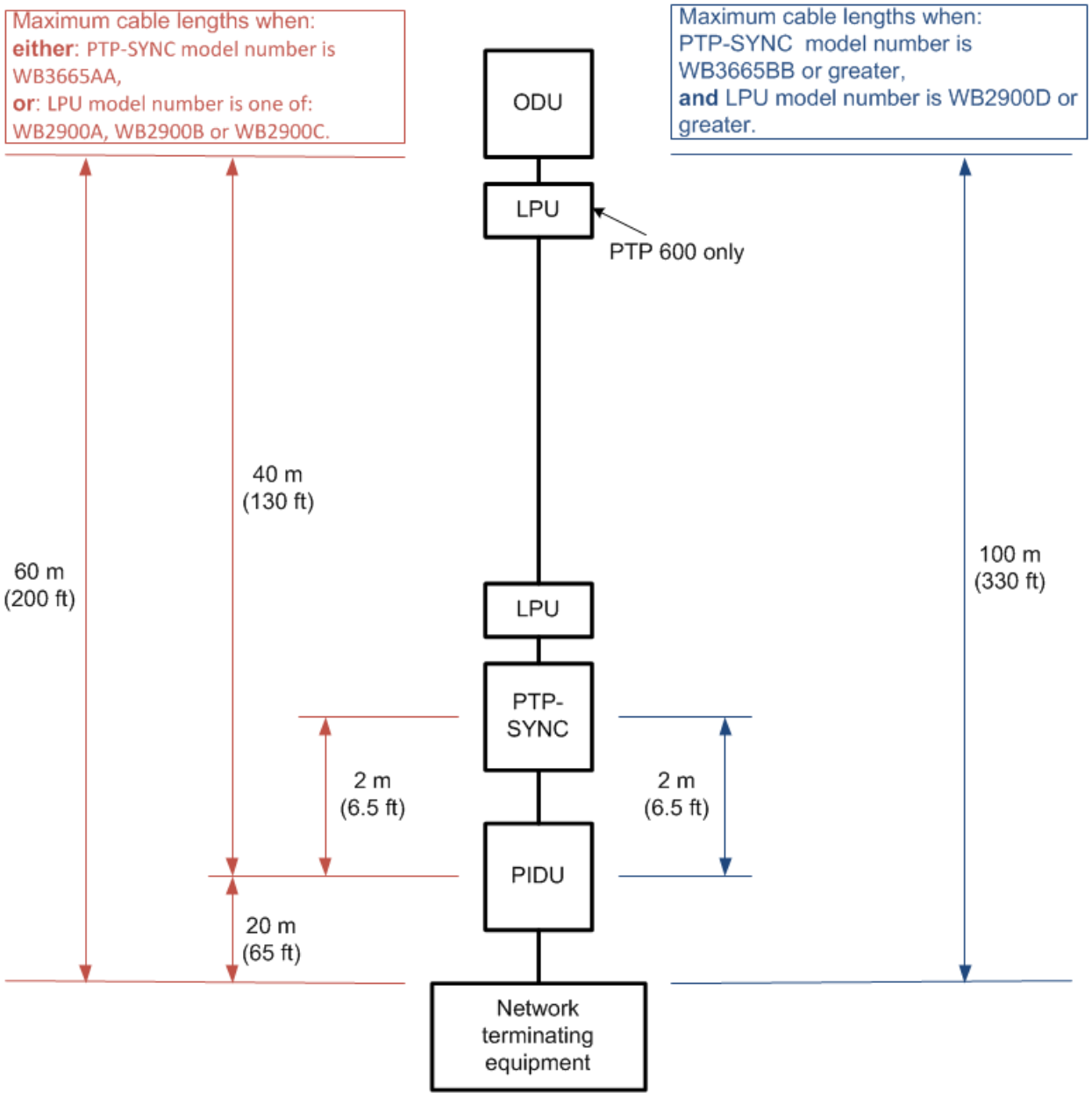
Maximum cable lengths

When PTP-SYNC is not installed:

- The maximum permitted length of the copper Ethernet interface cable is 100 m (330 ft) from ODU to network terminating equipment.
- If the copper Ethernet interface supplies power only (because fiber Ethernet is installed), the maximum permitted length of the copper Ethernet interface cable is 240 m (790 ft) from ODU to PIDU.

When PTP-SYNC is installed, the maximum permitted lengths of each section of the copper Ethernet interface cable are as specified in (Figure 29).

Figure 29 Cable length restrictions when PTP-SYNC is installed



The maximum lengths of the other copper Ethernet interfaces are specified in Table 8.

Table 8 Maximum cable lengths of other copper Ethernet interfaces

Interface type	Interface	Maximum length
E1 or T1	ODU to network terminating equipment	100 m (330 ft)
OOBM	ODU to network terminating equipment	100 m (330 ft)
GPS	GPS receiver to PTP-SYNC	100 m (330 ft)

Fiber

The maximum permitted length of the fiber Ethernet interface cable (ODU to network equipment) depends upon which version of the SFP module is installed: 1000BaseSX (850 nm) or 1000BaseLX (1310 nm). Other factors that determine maximum length are: core and cladding thickness, operating mode and bandwidth. Refer to Fiber specifications on page 4-6.

Wind loading

Ensure that the site will not be prone to excessive wind loading.

Antennas and equipment mounted on towers or buildings will subject the mounting structure to significant lateral forces when there is appreciable wind. Antennas are normally specified by the amount of force (in pounds) for specific wind strengths. The magnitude of the force depends on both the wind strength and size of the antenna.

The ODU, with or without the integral antenna, is essentially a flat structure. The magnitude of the lateral force can be estimated from surface area and wind speed.

Calculation of lateral force (metric)

The magnitude of the lateral force can be estimated from:

Force (in kilogrammes) = $0.1045aV^2$

Where:	**Is:**
a	surface area in square meters
V	wind speed in meters per second

The lateral force produced by a single PTP 600 ODU (integrated or connectorized model) at different wind speeds is shown in Table 9.

Table 9 Lateral force – metric

Type of ODU	Largest surface area (square meters)	Lateral force (Kg) at wind speed (meters per second)				
		30	40	50	60	70
Integrated	0.130	12	22	34	49	66
Connectorized	0.093	9	16	24	35	48

Calculation of lateral force (US)

The magnitude of the lateral force can be estimated from:

Force (in pounds) = $0.0042Av^2$

Where:	Is:
A	surface area in square feet
v	wind speed in miles per hour

The lateral force produced by a single PTP 600 ODU (integrated or connectorized model) at different wind speeds is shown in Table 10.

Table 10 Lateral force – US

Type of ODU	Largest surface area (square feet)	Lateral force (lb) at wind speed (miles per hour)				
		80	100	120	140	150
Integrated	1.36	36.6	57.1	82.3	146.2	228.5
Connectorized	1.00	26.9	42	60.5	107.5	168.0

NOTE
When the connectorized ODU is used with external antennas, the figures from the antenna manufacturer for lateral force should be included to calculate the total loading on the mounting structure.

Capabilities of the PTP 600 Series

The structure and mounting brackets of the ODU are capable of withstanding wind speeds up to 242 kph (151 mph). Ensure that the structure to which the ODU is fixed to is also capable of withstanding the prevalent wind speeds and loads.

Wind speed statistics

Contact the national meteorological office for the country concerned to identify the likely wind speeds prevalent at the proposed location. Use this data to estimate the total wind loading on the support structures. Sources of information:

- US National Weather Service, http://www.nws.noaa.gov/
- UK Meteorological Office, www.meto.gov.uk

Hazardous locations

Check that the ODUs will not be exposed to hazardous gases, as defined by Hazloc (USA) and ATEX (Europe). If there is a risk of such exposure, then order the PTP 54600 or PTP 58600 ATEX/Hazloc product variants, as these are intended for operation in locations with gas hazards. The ATEX and Hazloc standards limit the EIRP as shown in Table 11.

Table 11 EIRP limits from ATEX and Hazloc standards

ATEX gas group	Hazloc gas group	Typical gas type	Maximum EIRP (Watt)
IIA	D	Propane	6
IIB	C	Ethylene	3.5
IIC	B	Hydrogen	2
IIC	A	Acetylene	2

For more information, refer to:

- PTP 600 kits on page 2-53
- Hazardous location compliance on page 4-56
- The *PTP 600 Series Hazardous Location Guide*.

Link planning

This section describes factors to be taken into account when planning links, such as range, obstacles path loss and throughput. PTP LINKPlanner is recommended.

PTP LINKPlanner

The Cambium PTP LINKPlanner software and user guide may be downloaded from the support website (see Contacting Cambium Networks on page 2).

PTP LINKPlanner imports path profiles and predicts data rates and reliability over the path. It allows the system designer to try different antenna heights and RF power settings. It outputs an installation report that defines the parameters to be used for configuration, alignment and operation. The installation report can be used to compare the predicted and actual performance of the link.

Range and obstacles

Calculate the range of the link and identify any obstacles that may affect radio performance.

Perform a survey to identify all the obstructions (such as trees or buildings) in the path and to assess the risk of interference. This information is necessary in order to achieve an accurate link feasibility assessment.

The PTP 600 Series is designed to operate in Non-Line-of-Sight (NLoS) and Line-of-Sight (LoS) environments. An NLOS environment is one in which there is no optical line-of-sight, that is, there are obstructions between the antennas.

The PTP 600 Series will operate at ranges from 100 m (330 ft) to 200 km (124 miles), within 3 modes: 0-40 km (0-25 miles), 0-100 km (0-62 miles) and 0-200 km (0-124 miles). Operation of the system will depend on obstacles in the path between the units. Operation at 40 km (25 miles) or above will require a near line-of-sight path. Operation at 100 m (330 ft) could be achieved with one unit totally obscured from the other unit, but with the penalty of transmitting at higher power in a non-optimal direction, thereby increasing interference in the band.

LoS links in radar regions

When planning an LoS link to operate in a radar detection region, ensure that receiver signal level is low enough to allow the PTP 600 to detect radar signals:

- With integrated antennas, the recommended minimum LoS operating range is 180 meters (580 ft) for 5.4 GHz or 300 meters (990 ft) for 5.8 GHz. Shorter operating ranges will lead to excessive receiver signal levels.
- With higher gain connectorized antennas, the recommended minimum predicted receiver signal level (from LINKPlanner) is -53 dBm for 5.4 GHz or -58 dBm for 5.8 GHz.

PTP LINKPlanner for synchronized networks

TDD synchronization should be planned using PTP LINKPlanner. This will provide the necessary TDD Frame parameter values which are required to complete a synchronized installation. Please refer to the *PTP LINKPlanner User Guide*.

Path loss considerations

Path loss is the amount of attenuation the radio signal undergoes between the two ends of the link.

Calculating path loss

The path loss is the sum of the attenuation of the path if there were no obstacles in the way (Free Space Path Loss), the attenuation caused by obstacles (Excess Path Loss) and a margin to allow for possible fading of the radio signal (Fade Margin). The following calculation needs to be performed to judge whether a particular link can be installed:

$$L_{free\_space} + L_{excess} + L_{fade} + L_{seasonal} < L_{capability}$$

Where:	Is:
L_{free_space}	Free Space Path Loss (dB)
L_{excess}	Excess Path Loss (dB)
L_{fade}	Fade Margin Required (dB)
$L_{seasonal}$	Seasonal Fading (dB)
$L_{capability}$	Equipment Capability (dB)

Adaptive modulation

Adaptive modulation ensures that the highest throughput that can be achieved instantaneously will be obtained, taking account of propagation and interference. When the link has been installed, web pages provide information about the link loss currently measured by the equipment, both instantaneously and averaged. The averaged value will require maximum seasonal fading to be added, and then the radio reliability of the link can be computed. For minimum error rates on TDM links, the maximum modulation mode should be limited to 64QAM 0.75.

The values for (BPSK) are static receive sensitivity measurements. The other values are static receive sensitivity measurements with an AMOD threshold applied. The AMOD threshold applied is for a benign radio channel.

When selecting a modulation mode, the system is influenced by the parameters listed in Table 12.

Table 12 Parameters that influence modulation mode selection

Parameter	Meaning
Sensitivity	The combined receive input signal level on both horizontal and vertical inputs that produces a Null BER Error ratio of $3x10^{-7}$.
Output Power	The output power defaults to the region code limit selected for the link in question. The output power will be reduced on the edge channels and may vary if different region codes are selected.
AMOD Threshold	The AMOD threshold is the combined receive input signal level on both horizontal and vertical inputs that results in the link consistently entering the receive modulation mode under consideration as the signal level is increased.
System Threshold	Thresholds for all modes except BPSK are for the relevant link optimization AMOD thresholds. System threshold for BPSK is the RPSK receive sensitivity.
Max Link Loss	The maximum link loss for each modulation mode is derived from the AMOD threshold for that mode (sensitivity threshold for BPSK) and the maximum Region 1 center channel output power. The figures assume integral antennas are used, with gain depending upon frequency band as follows: 23 dBi (5.9 GHz, 5.8 GHz and 5.4 GHz) 22 dBi (4.8 GHz and 4.9 GHz) 21.5 dBi (4.5 GHz) 18 dBi (2.5 GHz)

System threshold, output power and link loss

For details of the system threshold, output power and link loss for each frequency variant in all modulation modes for all available channel bandwidths, refer to System threshold, output power and link loss on page 4-31.

Calculating data rate capacity

The data rate capacity of a PTP link is defined as the maximum end-to-end Ethernet throughput (including Ethernet headers) that it can support. It is assumed that Ethernet frames are 1500 octet. Data rate capacity is determined by the following factors:

- Product variant (PTP 600 Full or Lite)
- Link Symmetry
- Link Mode Optimization (IP or TDM)
- Modulation Mode
- Channel Bandwidth
- Link Range

Calculation procedure

To calculate the data rate capacity of a PTP 600 link, proceed as follows:

1. Use the tables in Data throughput capacity on page 4-74 to look up the data throughput capacity rates (Tx, Rx and Both) for the required combination of:

   Link Symmetry

   Link Mode Optimization

   Modulation Mode

   Channel Bandwidth

2. The tables contain data rates for PTP 600 Full only. If the ODUs are PTP 600 Lite, divide the data rates by 2.

3. The tables contain data rates for links of zero range. Use the curves in Range adjustment curves on page 4-85 to look up the Throughput Factor that must be applied to adjust the data rates for the actual range of the link.

4. Multiply the data rates by the Throughput Factor to give the throughput capacity of the link.

NOTE

There is a small difference between the rates for IP and TDM because there is fragmentation in TDM (for low priority traffic) which causes the throughput to be reduced by approximately 1% compared to the IP mode.

Calculation example

Suppose that the link characteristics are:

- Product variant = PTP 600 Lite
- Link Symmetry = 1:1
- Link Mode Optimization = TDM
- Modulation Mode = 64QAM 0.92 Dual
- Channel Bandwidth = 10 MHz
- Link Range = 60 km

The calculation procedure for this example is as follows:

1. Use Table 92 to look up the data throughput capacity rates:

   Tx = 41.41 Mbits/s

   Rx = 41.41 Mbits/s

   Both = 82.81 Mbits/s

2. Divide these rates by 2 to give PTP 600 Lite rates:

   Tx = 20.70 Mbits/s

   Rx = 20.70 Mbits/s

   Both = 41.40 Mbits/s

3. Use Figure 87 to look up the Throughput Factor for 1:1, TDM and Link Range 60 km. The factor is 0.86.

4. Multiply the rates from Step 2 by the Throughput Factor from Step 3 to give the throughput capacity of the link:

   Tx = 17.80 Mbits/s

   Rx = 17.80 Mbits/s

   Both = 35.60 Mbits/s

Planning for connectorized units

This section describes factors to be taken into account when planning to use connectorized ODUs with external antennas in PTP 600 links.

When to install connectorized units

The majority of radio links can be successfully deployed with the integrated PTP 600. However the integrated units may not be sufficient in some areas, for example:

- Where the path is heavily obscured by dense woodland on an NLOS link.
- Where long LOS links (>23 km or >14 miles) are required.
- Where there are known to be high levels of interference.

PTP LINKPlanner can be used to identify these areas of marginal performance.

In these areas, connectorized ODUs and external antennas should be used.

Choosing external antennas

When selecting external antennas, consider the following factors:

- The required antenna gain.
- Ease of mounting and alignment.
- Antenna polarization:
  - For a simple installation process, select one dual-polarization antenna (as the integrated antenna) at each end.
  - To achieve spatial diversity, select two single-polarization antennas at each end. Spatial diversity provides additional fade margin on very long LOS links where there is evidence of correlation of the fading characteristics on Vertical and Horizontal polarizations.

For connectorized units operating in the USA or Canada 5.4 GHz or 5.8 GHz bands, choose external antennas from those listed in FCC and IC approved antennas on page 2-64. Do not install any other antennas.

For links in other countries, it is not mandatory to choose antennas from FCC and IC approved antennas on page 2-64, but this may be used as a guide.

If an EIRP limit is in force, refer to Calculating maximum power level for connectorized units on page 2-18.

NOTE

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Calculating maximum power level for connectorized units

If a connectorized PTP 600 link is to be installed in a country that imposes an EIRP limit in the selected band, choose an external antenna and RF cable that will not cause the PTP 600 to exceed the EIRP limit. To calculate the highest setting of Maximum Power Level that will be permitted, use this formula:

Maximum Power Level (dBm) =

Allowed EIRP (dBm) – Antenna Gain (dBi) + Cable Loss (dB)

Where:	**Is:**
Maximum Power Level (dBm)	the highest permissible setting of the Maximum Power Level attribute in the Step 2: Wireless Configuration page,
Allowed EIRP (dBm)	the EIRP limit allowed by the regulations,
Antenna Gain (dBi)	the gain of the chosen antenna,
Cable Loss (dB)	the loss of the RF cable connecting the ODU to the antenna.

As the PTP 54600 and PTP 58600 have an operating bandwidth from approximately 5 MHz to approximately 30 MHz, then the maximum allowed EIRP depends on the operating bandwidth of the radio as shown in Table 13.

Table 13 Normal EIRP limits with operating channel bandwidth

Operating bandwidth (MHz)	Allowed EIRP (dBm) at 5.4 GHz	Allowed EIRP (dBm) at 5.8 GHz
5	24	30
10	27	33
15	28.8	34.8
30	30	36

The settings to be used for regions with the EIRP limits in Table 13 (assuming short feeder cables) are shown in Table 14.

Table 14 Setting maximum transmit power to meet general EIRP limits

Antenna size	Maximum available antenna gain (dBi)	Operating bandwidth (MHz)	Set_Max_Transmit_Power parameter setting (dBm)	
			5.4 GHz	5.8 GHz
2ft dish	29.4	5	-6	0
		10	-3	3
		15	-2	4
		30	1	7
2.5ft dish	31.2	5	Not allowed	-2
		10	-5	1
		15	-3	3
		30	0	6
3ft dish	33.4	5	Not allowed	-4
		10	-7	-1
		15	-5	0
		30	-2	3
4ft dish	34.8	5	Not allowed	-6
		10	Not allowed	-3
		15	-7	-1
		30	-4	2

> **NOTE**
> Table 14 has been calculated on the basis of 0.5 dB cable loss and the highest gain antennas per size of which Cambium are aware. At these operating frequencies, feeder losses even with short cables are unlikely ever to be below 0.5 dB for practical installations and cable diameters.

> **NOTE**
> Antenna Gain and Cable Loss must be entered correctly in the Installation Wizard, as they are used by the software to impose an automatic constaint on Maximum Power Level. For more information, see Step 2: Wireless configuration on page 6-51.

Calculating RF cable length (5.8 GHz FCC only)

The 5.8 GHz band FCC approval for the product is based on tests with a cable loss between the ODU and antenna of not less than 1.2 dB. If cable loss is below 1.2 dB with a 6 ft diameter external antenna, the connectorized PTP 600 may exceed the maximum radiated spurious emissions allowed under FCC 5.8 GHz rules.

Cable loss depends mainly upon cable type and length. To meet or exceed the minimum loss of 1.2 dB, use cables of the type and length specified in Table 15 (source: Times Microwave). This data excludes connector losses.

Table 15 RF cable lengths required to achieve 1.2 dB loss at 5.8 GHz

RF cable type	Minimum cable length
LMR100	0.6 m (1.9 ft)
LMR200	1.4 m (4.6 ft)
LMR300	2.2 m (7.3 ft)
LMR400	3.4 m (11.1 ft)
LMR600	5.0 m (16.5 ft)

Grounding and lightning protection

This section describes the grounding and lightning protection requirements of a PTP 600 installation.

WARNING

Electro-magnetic discharge (lightning) damage is not covered under warranty. The recommendations in this guide, when followed correctly, give the user the best protection from the harmful effects of EMD. However 100% protection is neither implied nor possible.

The need for power surge protection

Structures, equipment and people must be protected against power surges (typically caused by lightning) by conducting the surge current to ground via a separate preferential solid path. The actual degree of protection required depends on local conditions and applicable local regulations. Cambium recommends that PTP 600 installation is contracted to a professional installer.

Standards

Full details of lightning protection methods and requirements can be found in the international standards IEC 61024-1 and IEC 61312-1, the U.S. National Electric Code ANSI/NFPA No. 70-1984 or section 54 of the Canadian Electric Code.

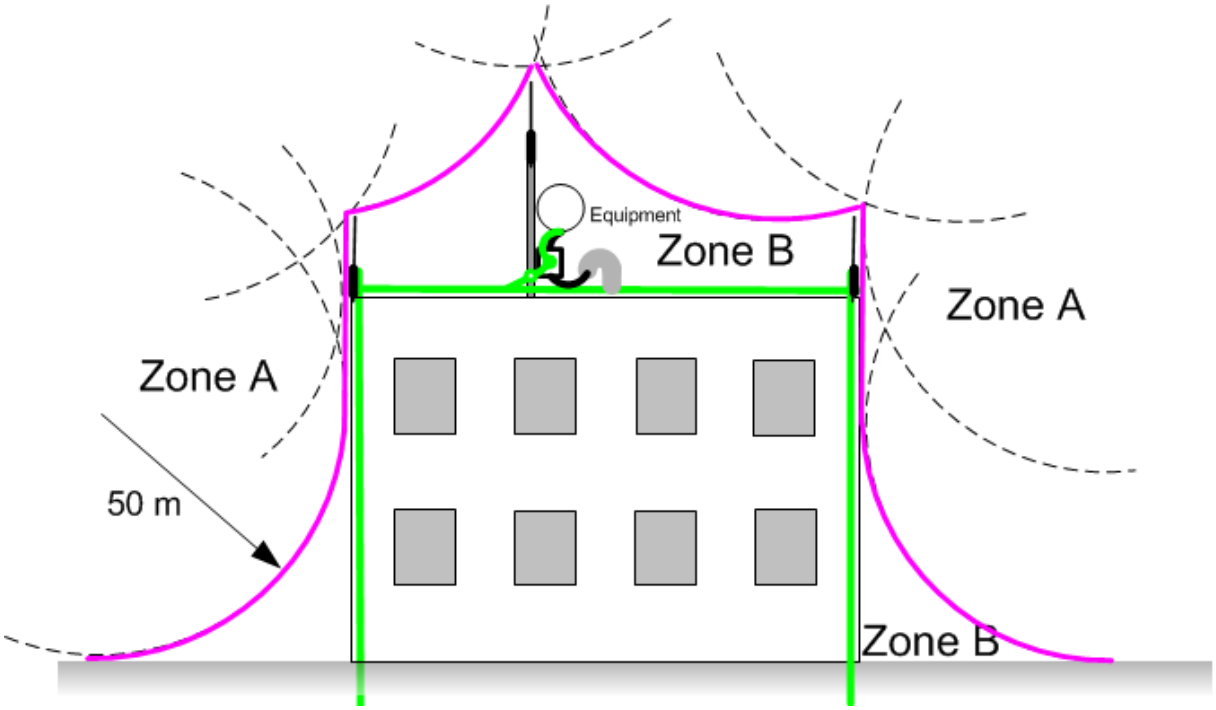
NOTE

International and national standards take precedence over the requirements in this guide.

Lightning protection zones

The 'rolling sphere method' (Figure 30) is used to determine where it is safe to mount equipment. An imaginary sphere, typically 50 meters in radius, is rolled over the structure. Where the sphere rests against the ground and a strike termination device (such as a finial or ground bar), all the space under the sphere is considered to be in the zone of protection (Zone B). Similarly, where the sphere rests on two finials, the space under the sphere is considered to be in the zone of protection.

Figure 30 Rolling sphere method to determine the lightning protection zones



Assess locations on masts, towers and buildings to determine if the location is in Zone A or Zone B:

- Zone A: In this zone a direct lightning strike is possible. Do not mount equipment in this zone.
- Zone B: In this zone, direct EMD (lightning) effects are still possible, but mounting in this zone significantly reduces the possibility of a direct strike. Mount equipment in this zone.

⚠ WARNING

Never mount equipment in Zone A. Mounting in Zone A may put equipment, structures and life at risk.

General protection requirements

To adequately protect a PTP 600 installation, both ground bonding and transient voltage surge suppression are required.

Basic requirements

The following basic protection requirements must be implemented:

- The equipment (ODU or GPS receiver for PTP-SYNC) must be in 'Zone B' (see Lightning protection zones on page 2-22).
- A lightning protection unit must be installed close to the ODU (the top LPU). The distance between the ODU and top LPU should be kept to a minimum.
- The drop cable length between the ODU and top LPU must not exceed 600 mm.
- The ODU and top LPU must be bonded in the following ways: top LPU to ODU; ODU to grounding system.
- An LPU must be installed within 600 mm (24 in) of the point at which the drop cable enters the building or equipment room.
- The drop cable must not be laid alongside a lightning air terminal.
- The drop cable shield must be bonded to the grounding system in order to prevent lightning creating a potential between the structure and cable, which could cause arcing, resulting in fire risk and damage to equipment.
- The drop cable shield must be grounded at the building entry point.
- All grounding cables must be a minimum size of 10 mm^2 csa (8AWG), preferably 16 mm^2 csa (6AWG), or 25 mm^2 csa (4AWG).

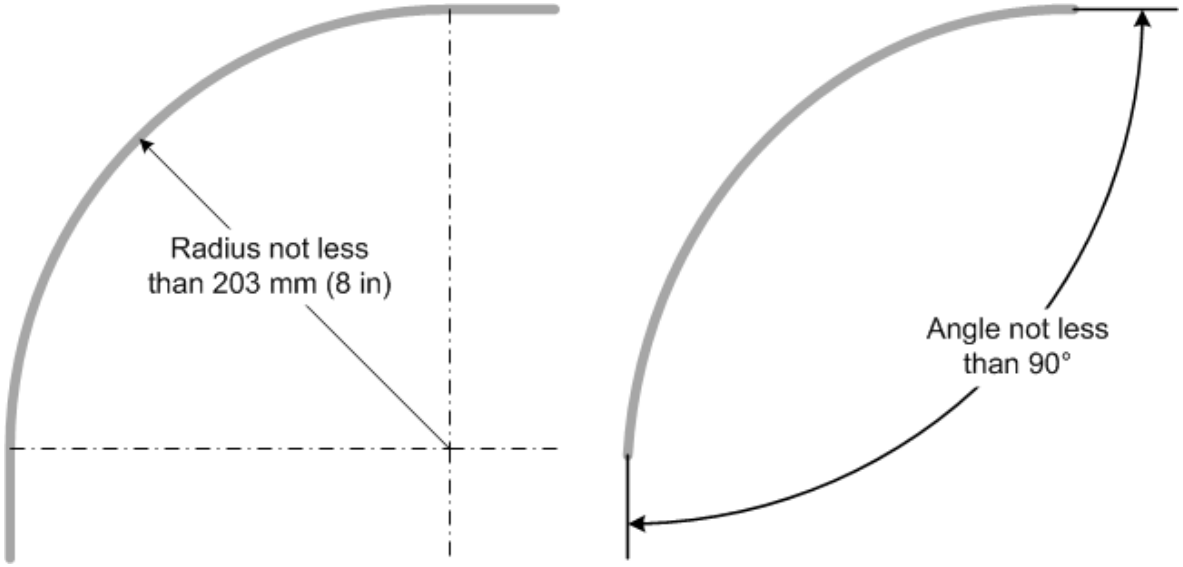
Grounding cable requirements

When routing, fastening and connecting grounding cables, the following requirements must be implemented:

- Grounding conductors must be run as short, straight, and smoothly as possible, with the fewest possible number of bends and curves.
- Grounding cables must not be installed with drip loops.
- All bends must have a minimum radius of 203 mm (8 in) and a minimum angle of 90° (Figure 31). A diagonal run is preferable to a bend, even though it does not follow the contour or run parallel to the supporting structure.
- All bends, curves and connections must be routed towards the grounding electrode system, ground rod, or ground bar.
- Grounding conductors must be securely fastened.

- Braided grounding conductors must not be used.
- Approved bonding techniques must be used for the connection of dissimilar metals.

Figure 31 Grounding cable minimum bend radius and angle



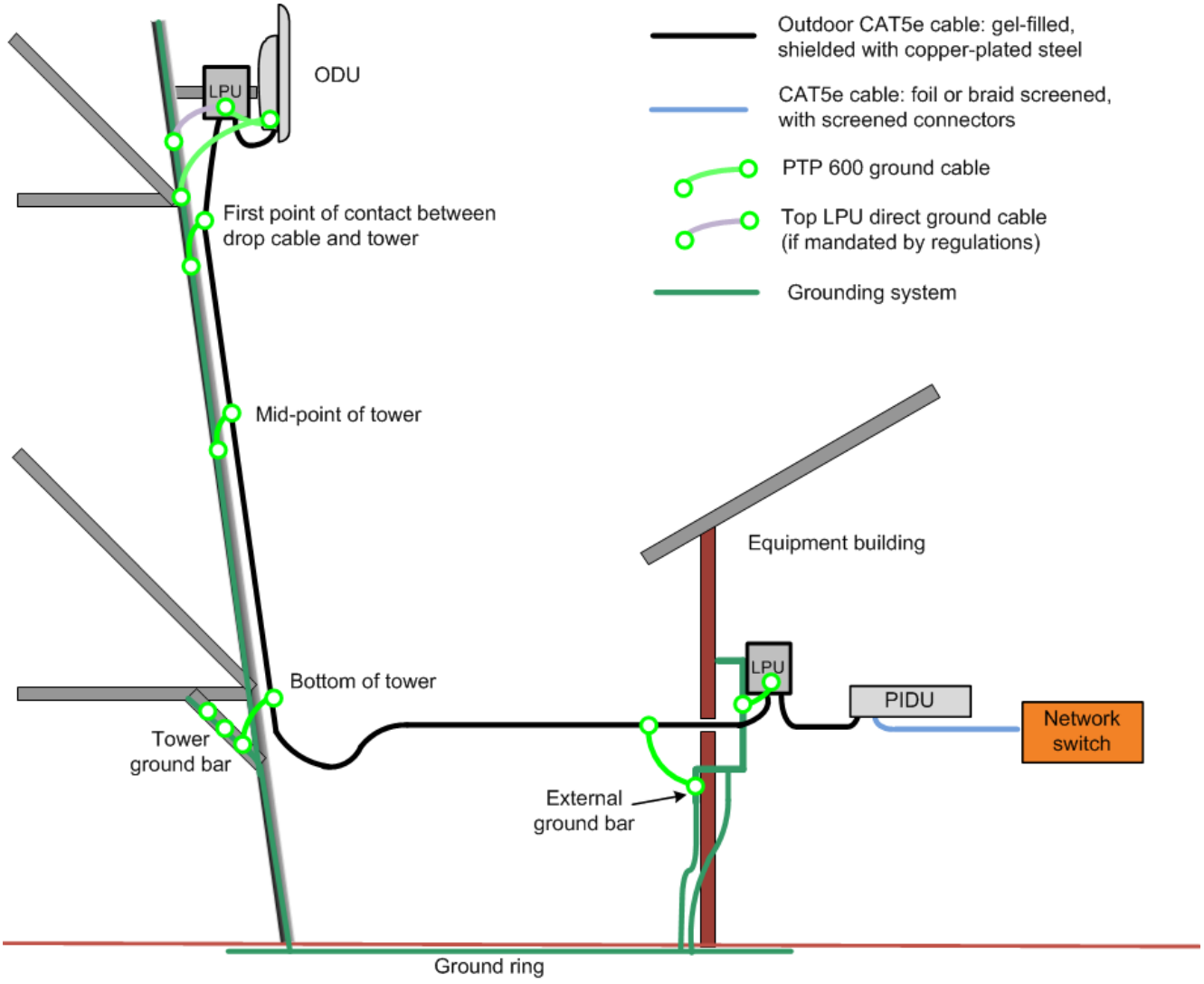
Protection requirements for a mast or tower installation

If the ODU is to be mounted on a metal tower or mast, then in addition to the general protection requirements (above), the following requirements must be observed:

- The equipment must be lower than the top of the tower or its lightning air terminal.
- The metal tower or mast must be correctly grounded.
- A grounding kit must be installed at the first point of contact between the drop cable and the tower, near the top.
- A grounding kit must be installed at the bottom of the tower, near the vertical to horizontal transition point. This grounding kit must be bonded to the tower or tower ground bus bar (TGB), if installed.
- If the tower is greater than 61 m (200 ft) in height, an additional grounding kit must be installed at the tower midpoint. Additional ground kits must be installed as necessary to reduce the distance between ground kits to 61 m (200 ft) or less.
- In high lightning prone geographical areas, additional ground kits should be installed at spacing between 15 to 22 m (50 to 75 ft). This is especially important on towers taller than 45 m (150 ft).

A schematic example of a mast or tower installation is shown in Figure 32.

Figure 32 Grounding and lightning protection on mast or tower



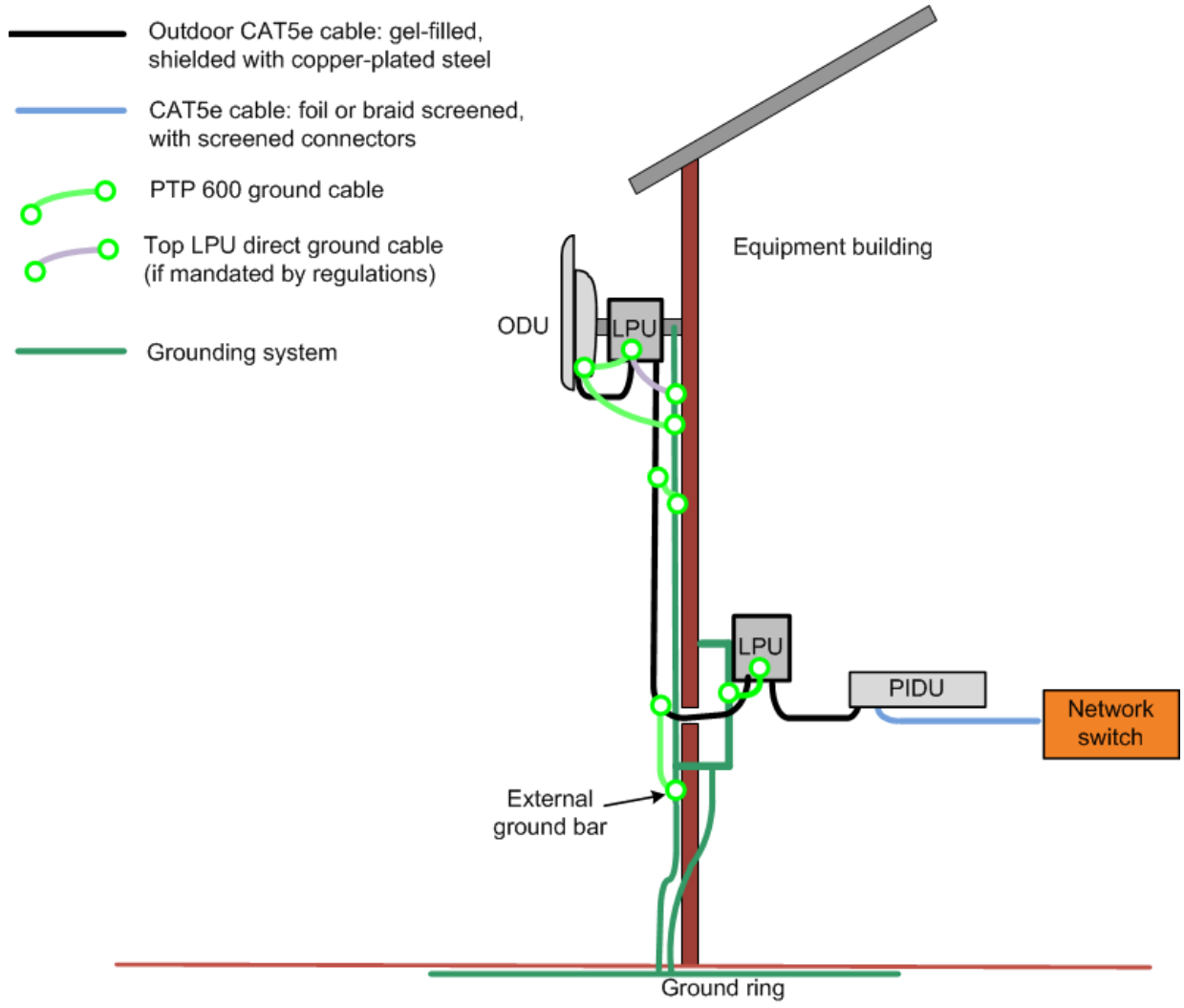
Protection requirements for a wall installation

If the ODU is to be mounted on the wall of a building, then in addition to the general protection requirements (above), the following requirements must be observed:

- The equipment must be lower than the top of the building or its lightning air terminal.
- The building must be correctly grounded.

A schematic example of a wall installation is shown in Figure 33.

Figure 33 Grounding and lightning protection on wall

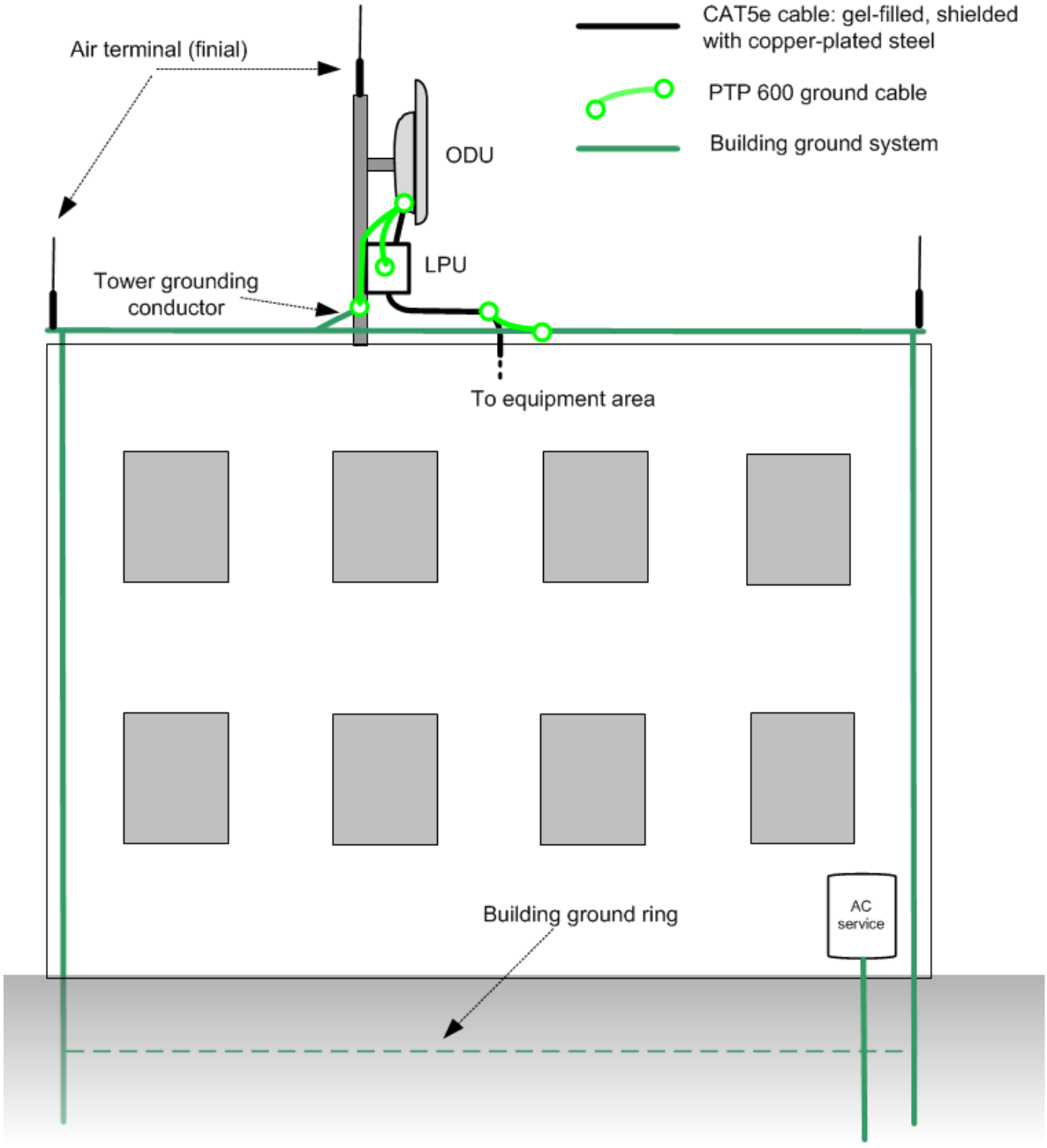


Protection requirements on a high rise building

If the ODU is to be mounted on a high rise building, it is likely that cable entry is at roof level (Figure 34) and the equipment room is several floors below (Figure 35). The following additional requirements must be observed:

- The ODU must be below the lightning terminals and finials.
- A grounding conductor must be installed around the roof perimeter, to form the main roof perimeter lightning protection ring.
- Air terminals are typically installed along the length of the main roof perimeter lightning protection ring typically every 6.1m (20ft).
- The main roof perimeter lightning protection ring must contain at least two down conductors connected to the grounding electrode system. The down conductors should be physically separated from one another, as far as practical.

Figure 34 Grounding and lightning protection on building

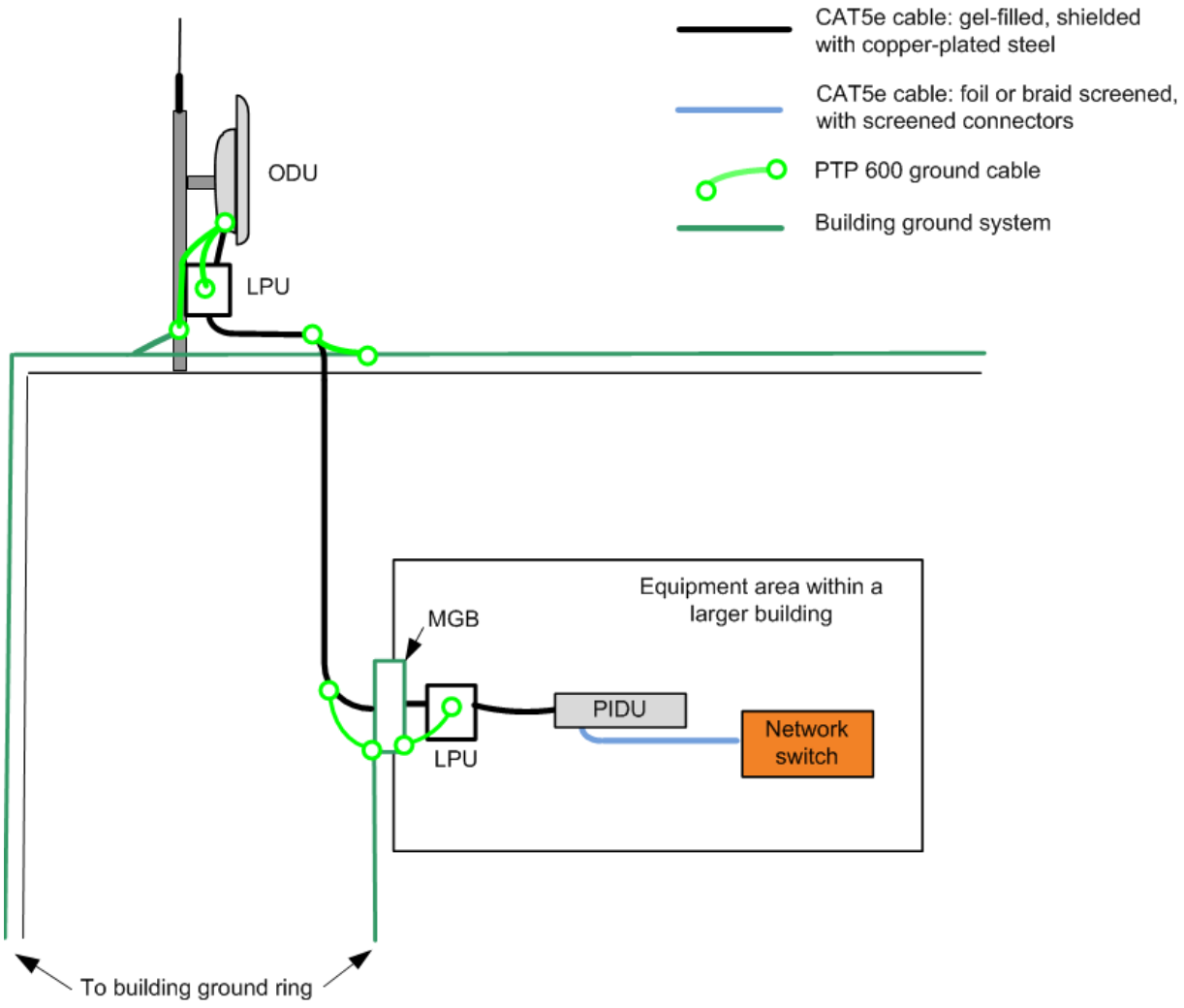


Protection inside a high rise building

The following protection requirements must be observed inside multi-story or high rise buildings (Figure 35):

- The drop cable shield must be bonded to the building grounding system at the entry point to the building.
- The drop cable shield must be bonded to the building grounding system at the entry point to the equipment area.
- An LPU must be installed within 600 mm (24 in) of the entry point to the equipment area.

Figure 35 Grounding and lightning protection inside high building



Configuration options for TDD synchronization

This section describes the different configuration options that may be used for implementing TDD synchronization in the PTP 600 Series. Schematic diagrams are included.

The PTP 600 supports the following TDD synchronization configurations:

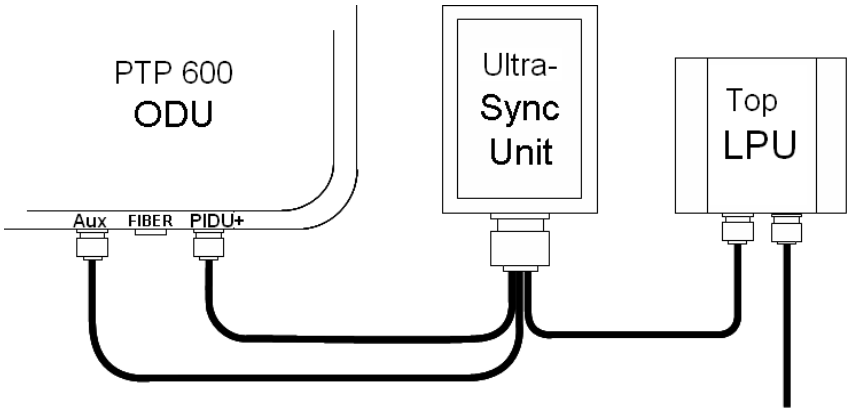
- Single link configuration with UltraSync on page 2-30.
- Single link configuration with PTP-SYNC on page 2-31.
- Cluster with PTP-SYNC and GPS receiver on page 2-32.
- Cluster with PTP-SYNC and no GPS receiver on page 2-33.

Single link configuration with UltraSync

Each link requires an UltraSync GPS receiver, connected at the master ODU (Figure 36). The wireless configuration settings are:

- Master Slave Mode = ‘Master’.
- TDD Sync Device = ‘UltraSync’.

Figure 36 TDD synchronization configuration – standalone with UltraSync



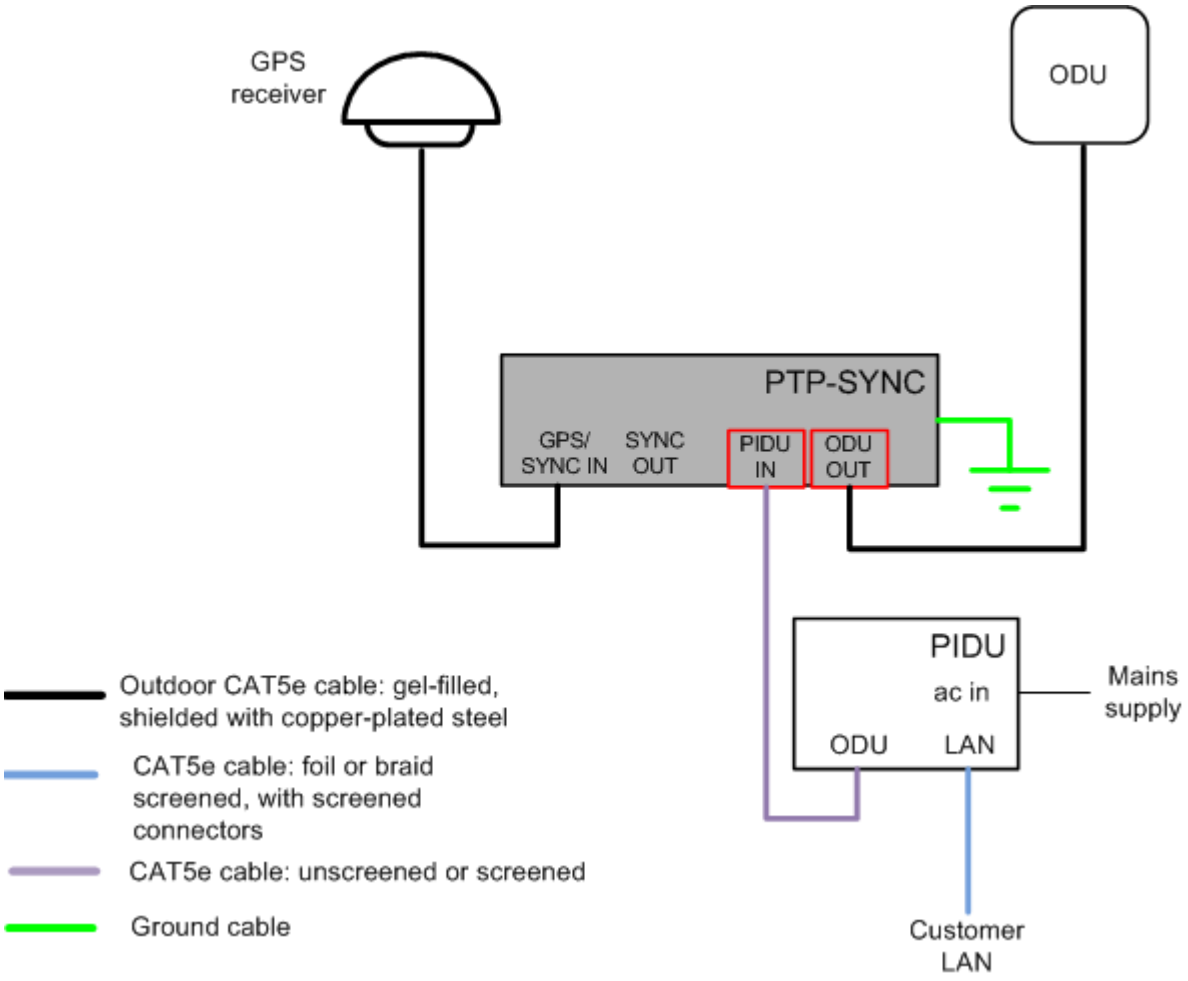
Single link configuration with PTP-SYNC

Each link requires one PTP-SYNC unit connected to the master ODU and one compatible GPS receiver. Use this configuration where a site contains only one TDD master ODU. The GPS receiver and LPU can be replaced by an alternative compatible 1 Hz timing reference (Figure 37).

The wireless configuration settings are:

- Master Slave Mode = ‘Master’.
- TDD Sync Device = ‘PTPSYNC’.
- Cluster Master Slave = ‘Cluster Master’.
- PTP Sync Site Reference = ‘GPS/1PPS External’.

Figure 37 TDD synchronization configuration – single link with PTP-SYNC



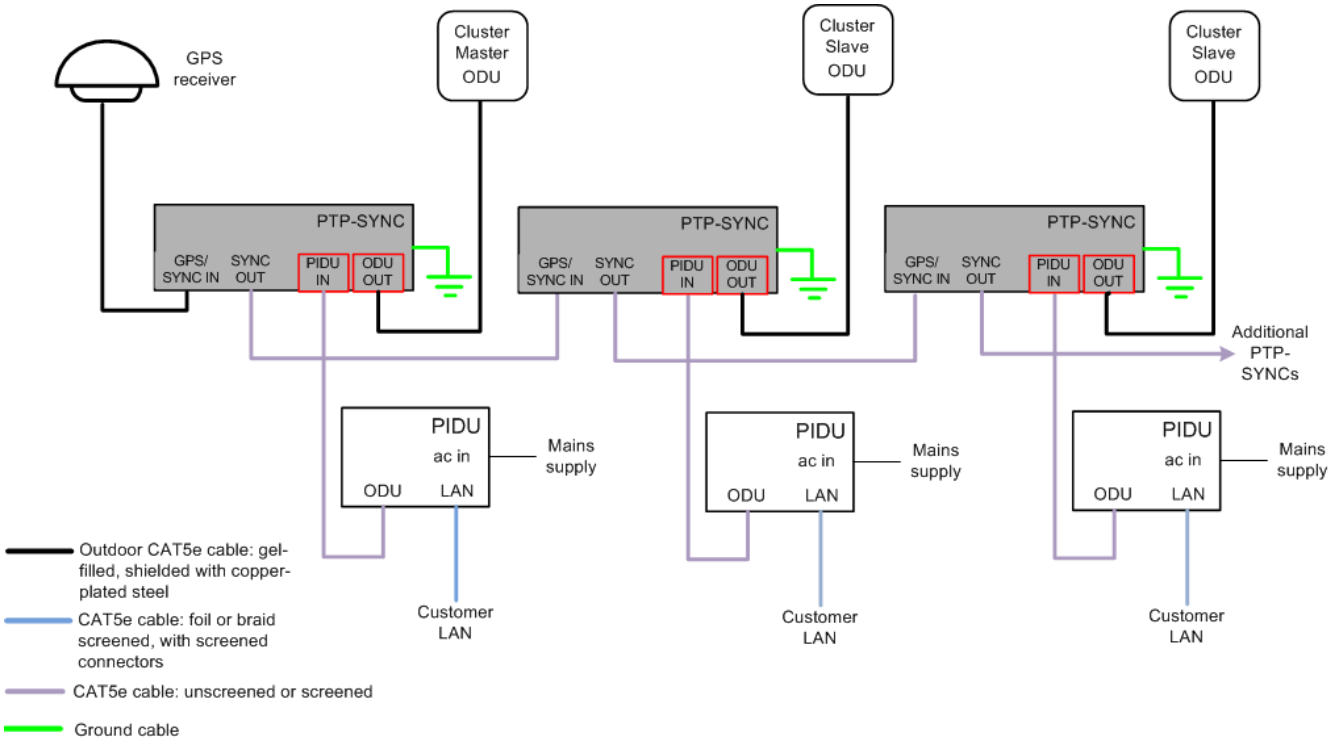
Cluster with PTP-SYNC and GPS receiver

Each link requires one PTP-SYNC unit. Each site requires one compatible GPS receiver. Collocated PTP-SYNC units are connected together in a daisy-chain. Between two and ten PTP-SYNCs may be chained in this way. Use this configuration where a site contains collocated TDD master ODUs in an extended network and where multiple sites have TDD master ODUs (Figure 38).

The wireless configuration settings are:

- Master Slave Mode = ‘Master’ (all ODUs in cluster).
- TDD Sync Device = ‘PTPSYNC’ (all ODUs in cluster).
- Cluster Master Slave = ‘Cluster Master’ (first ODU) and ‘Cluster Slave’ (others).
- PTP Sync Site Reference = ‘GPS/1PPS External’ (all ODUs in cluster).

Figure 38 TDD synchronization configuration – cluster with PTP-SYNC and GPS



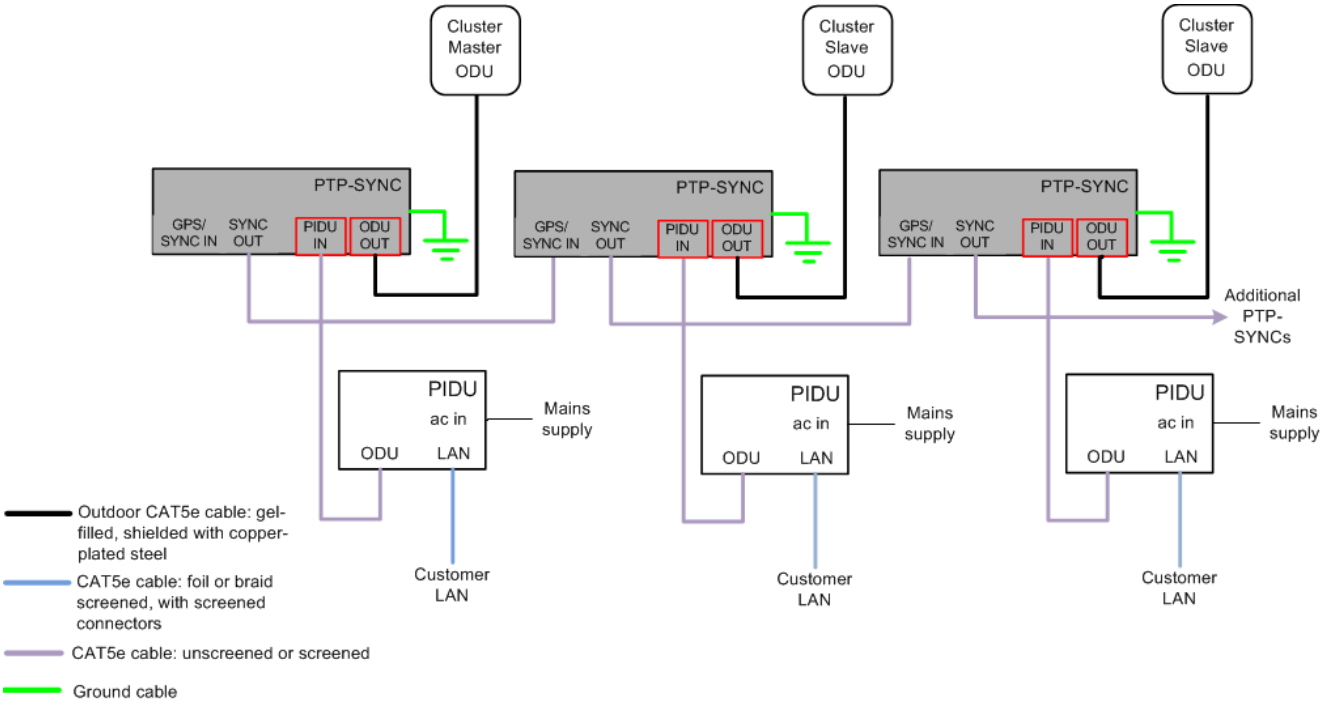
Cluster with PTP-SYNC and no GPS receiver

Each link requires one PTP-SYNC unit. PTP-SYNC units are connected together in a daisy-chain. Between two and ten PTP-SYNCs may be chained in this way. One ODU is designated as a cluster timing master. Use this configuration where all master ODUs are collocated at a single site. As this configuration does not require a GPS receiver, it provides additional flexibility, particularly in applications requiring rapid deployment (Figure 39).

The wireless configuration settings are:

- Master Slave Mode = ‘Master’ (all ODUs in cluster).
- TDD Sync Device = ‘PTPSYNC’ (all ODUs in cluster).
- Cluster Master Slave = ‘Cluster Master’ (first ODU) and ‘Cluster Slave’ (others).
- PTP Sync Site Reference = ‘Internal’ (all ODUs in cluster).

Figure 39 TDD synchronization configuration – cluster with PTP-SYNC and no GPS



Mounting options for the PTP-SYNC GPS receiver

This section describes the requirements of the (optional) GPS receiver for PTP-SYNC.

If PTP-SYNC is to be installed with a GPS receiver as the timing reference source, then the GPS receiver must be mounted as described in this section.

CAUTION

Ensure that the GPS receiver module is mounted in a position where all protection requirements can be met.

NOTE

The GPS receiver is not approved for operation in locations where gas hazards exist, as defined by Hazloc (USA) and ATEX (Europe). If PTP-SYNC is required in a hazardous location then the timing reference source must be either a PTP 600 ODU or a cabled 1 Hz signal from a system approved for Hazardous locations.

GPS receiver location requirements

The GPS receiver for PTP-SYNC must be mounted at a location that meets the following requirements:

- It must be possible to protect the installation as described in General protection requirements on page 2-23.
- It must have an un-interrupted view of the sky.
- It must receive an adequate signal from at least four GPS satellites.
- It must be mounted at least 1 m (3 ft), preferably 2 m (6 ft), away from other GPS receiving equipment.
- It must not be sited in the field of radiation of co-located radio communications equipment and should be positioned at a distance of at least 3 m (10 ft) away.

Mount the GPS receiver on the wall of the equipment building, if there is a suitable location on the wall that can meet these requirements. Failing that, mount it on a metal tower or mast.

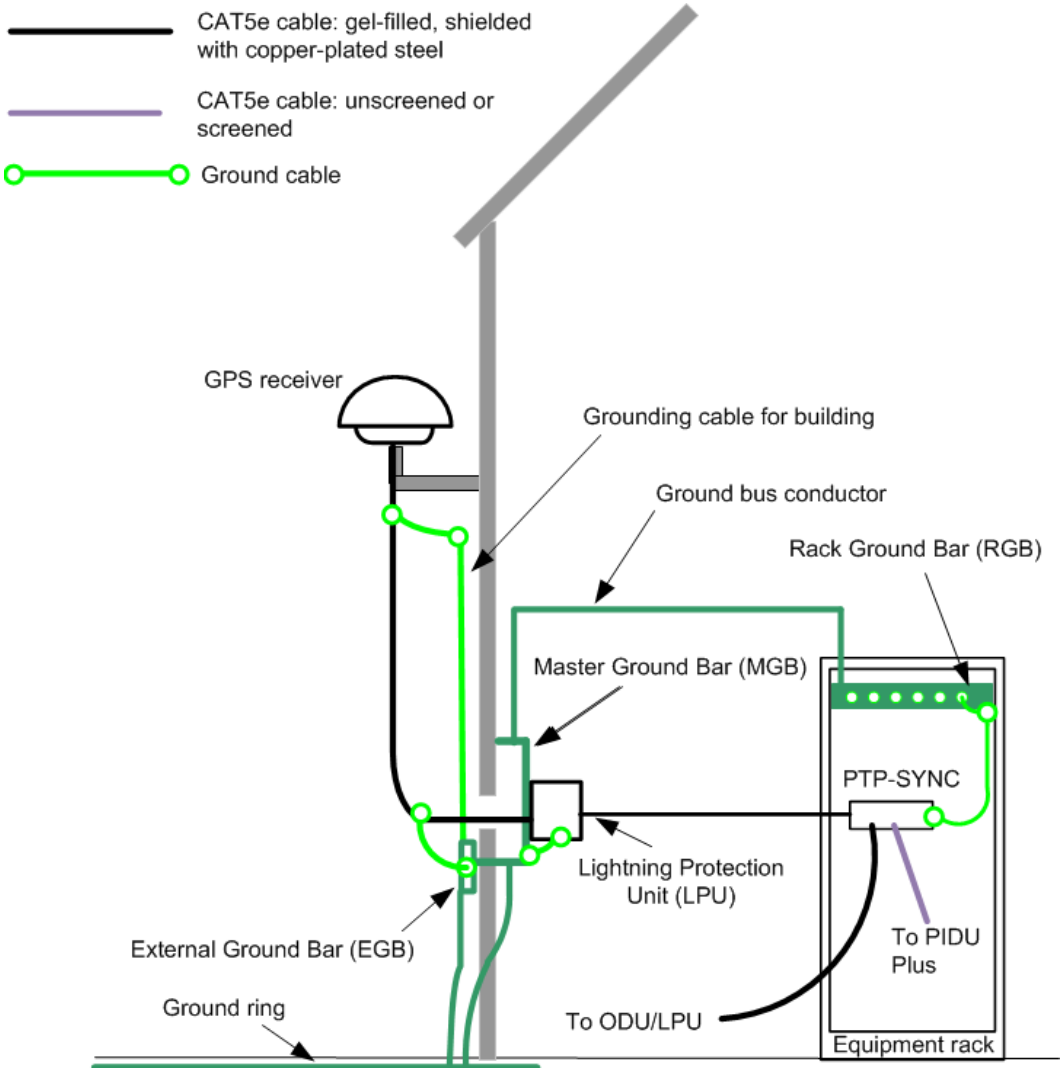
Mounting the GPS receiver module on the equipment building

If mounting the GPS receiver for PTP-SYNC on the equipment building (Figure 40), select a position on the wall that meets the following requirements:

- It must be below the roof height of the equipment building or below the height of any roof-mounted equipment (such as air conditioning plant).
- It must be below the lightning air terminals.
- It must not project more than 600mm (24 inches) from the wall of the building.

If these requirements cannot all be met, then the module must be mounted on a metal tower or mast.

Figure 40 Grounding and lightning protection for GPS receiver on building

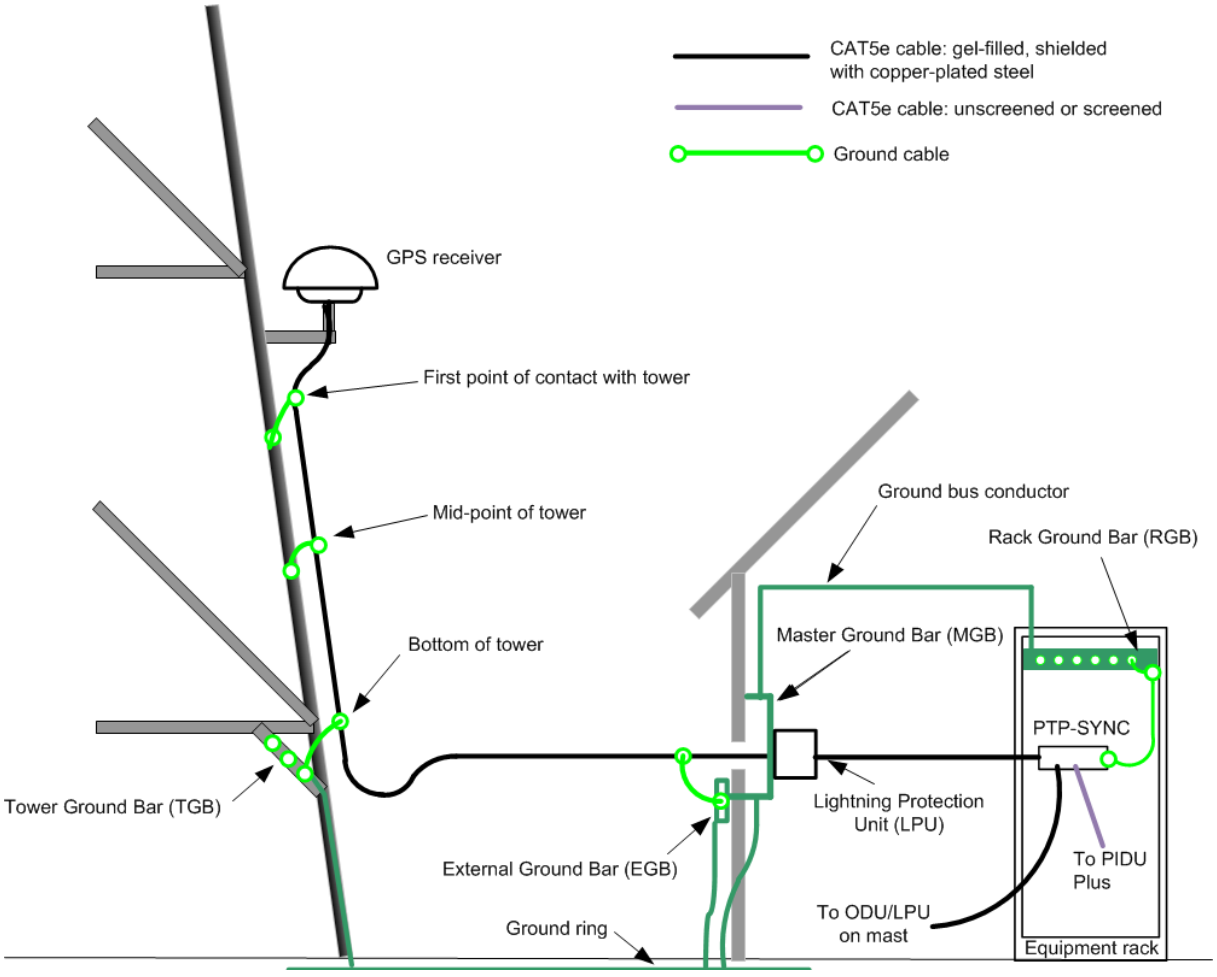


Mounting the GPS receiver module on a metal tower or mast

If mounting the GPS receiver module on a metal tower or mast (Figure 41), select a position that meets the following requirements:

- It must not be mounted any higher than is necessary to receive an adequate signal from four GPS satellites.
- It must be protected by a nearby lightning air terminal that projects farther out from the tower than the GPS receiver module.
- It must meet all the requirements stated in Protection requirements for a mast or tower installation on page 2-24.

Figure 41 Grounding and lightning protection for GPS receiver on tower or mast



Data network planning

This section describes factors to be considered when planning PTP 600 data networks.

Management mode

Decide how the PTP 600 will be managed.

In many network applications the wireless link will provide the only communication path to a remote site. In such applications, ODUs and other network equipment at the remote site will be managed over the wireless link. For applications of this type, select either out-of-band or in-band management mode.

Make sure that the same management mode is selected for ODUs at both ends of a link. See Management network on page 1-40 for further explanation of management modes.

In-band modes

In the in-band management modes, management traffic is multiplexed with customer traffic at a single physical interface.

In the default **in-band** management mode, the management agent can be reached from the PIDU+ port at the local ODU, and (assuming that the wireless link is established) from the PIDU+ port at the remote ODU.

In the alternative **in-band local** management mode, the IP interface of the management agent is always connected in a VLAN, and Ethernet frames in this management VLAN are filtered (discarded) at the wireless port. Use the in-band local management mode in networks that require only local access to the ODU management agent. For correct operation of in-band local management mode, ensure that the same management VLAN ID is configured at both ends of the link.

Out-of-band modes

In the out-of-band management modes, management traffic is segregated using a physically separate network interface connected to the AUX port of the ODU. Out-of-band management is available only in the PTP 45600, PTP 54600 OOBM and PTP 58600 OOBM variants.

In **out-of-band local** management mode, the management agent can be reached only from the AUX port of the local ODU. This mode is appropriate during installation when the equipment is managed using a locally connected PC at each end of the link. It may additionally be useful where network management communication is based on a completely independent data network (for example, one based on a 3G cellular wireless terminal at each site).

In the **out-of-band** management mode, the management agent can be reached from the AUX port at the local ODU, and (assuming that the wireless link is established) the AUX port at the remote ODU. End-to-end out-of-band management is possible only when the network management mode is configured to “out-of-band” at every ODU.

> **NOTE**
> The capacity of the out of band network is approximately 500 kbit/s at the wireless interface. Use in-band management where the loading of the management network is likely to exceed this capacity.

VLAN membership

Decide if the IP interface of the ODU management agent will be connected in a VLAN. If so, decide if this is a standard (IEEE 802.1Q) VLAN or provider bridged (IEEE 802.1ad) VLAN, and select the VLAN ID for this VLAN.

Use of a separate management VLAN is strongly recommended. Use of the management VLAN helps to ensure that the ODU management agent cannot be accessed by customers.

The in-band local management mode is not available unless the IP interface is connected in a VLAN.

Priority for management traffic

Choose the Ethernet and IP (DSCP) priority for management traffic generated within the ODU management agent. The priority should be selected so as to be consistent with existing policy on priority of management traffic in the network. Use of a high priority is strongly recommended to ensure that management traffic is not discarded if the link is overloaded.

Ensure that the priority assigned to management traffic is consistent with the quality of service scheme configured for bridged Ethernet traffic. If QoS for bridged traffic is based on the IP/MPLS scheme, set the DSCP management priority to map to a high priority queue. If QoS for bridged traffic is based on the Ethernet scheme, set the VLAN management priority to map to a high priority queue.

IP interface

Choose an IP address for the IP interface of the ODU management agent. The IP address must be unique and valid for the connected network segment and VLAN.

Find out the correct subnet mask and gateway IP address for this network segment and VLAN.

Ensure that the design of the data network permits bi-direction routing of IP datagrams between network management systems and the ODUs. For example, ensure that the gateway IP address identifies a router or other gateway that provides access to the rest of the data network.

Quality of service for bridged Ethernet traffic

Decide how quality of service will be configured in PTP 600 to minimise frame loss and latency for high priority traffic. Wireless links often have lower data capacity than wired links or network equipment like switches and routers, and quality of service configuration is most critical at network bottlenecks.

PTP 600 provides eight queues for traffic waiting for transmission over the wireless link. Q0 is the lowest priority queue and Q7 is the highest priority queue. Traffic is scheduled using strict priority; in other words, traffic in a given queue is transmitted when all higher-priority queues are empty.

Layer 2 control protocols

Select the transmission queue for each of the recognised layer 2 control protocols (L2CP). These protocols are essential to correct operation of the Ethernet network, and are normally mapped to a high priority queue. Ethernet frames that match one of the recognised L2CPs are not subject to the Ethernet and IP/MPLS classification described below.

Priority schemes

Select the priority scheme based on Ethernet priority or IP/MPLS priority to match QoS policy in the rest of the data network. Ethernet priority is also known as Layer 2 or link layer priority. IP/MPLS priority is also known as Layer 3 or network layer priority.

Ethernet priority scheme

Ethernet priority is encoded in a VLAN tag. Use the Ethernet priority scheme if the network carries traffic in customer or service provider VLANs, and the priority in the VLAN tag has been set to indicate the priority of each type of traffic. Select a suitable mapping from the Ethernet priority to the eight PTP 600 queues.

An advantage of Ethernet priority is that any VLAN-tagged frame can be marked with a priority, regardless of the higher-layer protocols contained within the frame. A disadvantage of Ethernet priority is that the priority in the frame must be regenerated whenever traffic passes through a router.

IP/MPLS priority scheme

IP priority is encoded in the DSCP field in an IPv4 or IPv6 header. The DSCP field provides 64 levels of priority. Determine the DSCP values used in the network and select a suitable mapping from these DSCP values to the eight PTP 600 queues.

An advantage of IP priority is that priority in the IP header is normally propagated transparently through a router. Also, the DSCP field supports a large number of distinct priority code points. A disadvantage of DSCP is that frames receive a single default classification if they contain a network layer protocol other than IPv4 or IPv6.

MPLS priority is encoded in the traffic class (TC) field in the outermost MPLS label. Select a suitable mapping from MPLS TC to the eight PTP 600 queues.

Back-to-back links

Avoid the use of direct cabled copper connections between two PIDUs. Where two or more links are deployed in a chain, use one of the following solutions:

- Copper or fiber connections between the PIDU and a suitable Ethernet switch or router.
- A fiber connection between two ODUs, with the 'Ethernet Media Type to Use' control set to 'Fiber Media Only'. For more information, refer to the *PTP 600 Series Optical Interface Upgrade Guide*.

'Green Ethernet' switches

Do not connect PTP 600 units to Ethernet networking products that control the level of the transmitted Ethernet signal based on the measured length of the Ethernet link, for example Green Ethernet products manufactured by D-Link Corporation. The Ethernet interfaces in these networking products do not work correctly when connected directly to the PTP 600 PIDU.

Security planning

This section describes how to plan for PTP 600 links to operate in secure mode.

Planning for SNTP operation

Before starting to configure Simple Network Time Protocol (SNTP):

- Identify the time zone and daylight saving requirements that apply to the system.
- Determine whether or not there is a requirement to synchronize the PTP 600 clock with an SNTP server at regular intervals. If SNTP server synchronization is not required, the clock can be set to run manually. The clock is battery backed and will continue to operate for several days after the ODU is switched off.
- If SNTP server synchronization is required, identify the details for one or two SNTP servers: IP address, port number and server key.
- For secure applications, the PTP 600 can be configured to authenticate received NTP messages using the DES protocol. This is a requirement when operating in UC APL secure mode.

Planning for HTTPS/TLS operation

Before starting to configure HTTPS/TLS operation, ensure that the cryptographic material listed in Table 16 is available.

Table 16 HTTPS/TLS security material

Item	Description	Quantity required
Key of Keys	An encryption key generated using a cryptographic key generator. The key length is dictated by the installed license key. License keys with AES-128 will require a key of keys of 128-bits. License keys with AES-256 will require a key of keys of 256-bits. The key output should be in ASCII hexadecimal characters.	Two per link. For greater security, each link end should be allocated a unique Key of Keys.

Item	Description	Quantity required
TLS Private Key and Public Certificates	An RSA private key of size 1024 or 2048 bytes, generated in either PKCS#1 or PKCS#5 format, unencrypted, and encoded in the ASN.1 DER format. An X.509 certificate containing an RSA public key, generated in either PKCS#1 or PKCS#5 format, unencrypted, and encoded in the ASN.1 DER format. The public key certificate must form a valid pair with the private key.	Two pairs per link. These items are unique to IP address.
User Defined Security Banner	The banner provides warnings and notices to be read by the user before logging in to the ODU. Use text that is appropriate to the network security policy.	Normally one per link. This depends upon network policy.
Entropy Input	This must be of size 512 bits (128 hexadecimal characters), output from a random number generator.	Two per link. For greater security, each link end should be allocated a unique Entropy Input.
Wireless Link Encryption Key for AES	An encryption key generated using a cryptographic key generator. The key length is dictated by the selected AES encryption algorithm (128 or 256 bits).	One per link. The same encryption key is required at each link end.
Port numbers for HTTP, HTTPS and Telnet	Port numbers allocated by the network.	As allocated by network.

Planning for FIPS 140-2 operation

If the link is to operate in FIPS 140-2 secure mode, ensure that the following cryptographic material is generated using a FIPS-approved cryptographic generator:

- Key of Keys
- TLS Private Key and Public Certificates
- Entropy Input
- Wireless Link Encryption Key for AES

Ensure that the web browsers used are enabled for HTTPS/TLS operation using FIPS-approved cipher specifications.

Ensure that following attributes of user accounts for the web-based management interface have been configured to match the operator's network security policy:

- Auto Logout Period.
- Maximum Number of Login Attempts.
- Login Attempt Lockout.
- Minimum Password Change Period.
- Password Expiry Period.
- Webpage Session Control

Ensure that the following are configured:

- Password complexity rules reset to 'best practice' values.
- User account passwords compliant with the network security policy.
- RADIUS authentication disabled.

⚠ CAUTION

Configure all of the above correctly to ensure that PTP 600 is operating in compliance with the FIPS 140-2 validation.

Planning for UC APL operation

If the link is to operate in UC APL secure mode, ensure that the following cryptographic material is generated using a FIPS-approved cryptographic generator:

- Key of Keys.
- TLS Private Key and Public Certificates (for the correct IP address):
  - these should be encoded in DER format;
  - maximum key size is 2048 bits.
- Entropy Input.
- Wireless Link Encryption Key for AES.

Ensure that a Common Access Card (CAC) enabled computer is available for use as a network management workstation for managing the PTP 600 units.

Determine the IP address of the CAC-enabled workstation; this will be configured in an Access Control List (ACL) in the PTP 600 units to prevent management access from other workstations.

Determine the required DoD password complexity requirements from the latest version of the *Application and Security Development Security Technical Implementation Guide (STIG)*. See, for example, Section 3.1.24.2 in Version 3 Release 4 of the STIG.

Select an installation location that affords significant physical security. For example, a location at least 10 meters (33 feet) from ground level, on the outside of a protected building, or on a telecommunications tower surrounded by protective fencing.

Ensure that the PTP 600 link will be installed behind the installation's protective firewall, within the installation's managed network infrastructure.

Ensure that the following are available in the network:

- A RADIUS authentication server, capable of supporting the PEAP(MS-CHAPv2) authentication method. For example, Microsoft Windows Server 2003.
- An SNTP server supporting DES or MD5 authentication.
- A syslog server (also known as a syslog collector).

⚠ CAUTION

Configure all of the above correctly to ensure that PTP 600 is operating in compliance with the UC APL validation.

Planning for SNMP operation

Supported notifications

The supported notifications are as follows:

- Cold start
- Wireless Link Up/Down
- DFS Channel Change
- DFS Impulse Interference
- Authentication Failure
- Ethernet Link Up/Down

Supported MIBs

Ensure that the following MIBs are loaded on the network management system.

- RFC-1493. BRIDGE-MIB
- RFC-2233. IF-MIB
- RFC-3411. SNMP-FRAMEWORK-MIB
- RFC-3412. SNMP-MPD-MIB
- RFC-3413. SNMP-TARGET-MIB
- RFC-3414. SNMP-USER-BASED-SM-MIB
- RFC-3415. SNMP-VIEW-BASED-ACM-MIB

- RFC-3418. SNMPv2-MIB
- RFC-3826. SNMP-USM-AES-MIB
- PTP 600 Series proprietary MIB

> **NOTE**
> The proprietary MIBs are provided in the PTP 600 Series software download files in the support website (see Contacting Cambium Networks on page 2).

Supported alarms

PTP 600 supports the following diagnostic alarms:

- Region Code
- Install Status
- Install Arm State
- Unit Out Of Calibration
- Incompatible Region Codes
- Incompatible Master And Slave
- Data Port Configuration Mismatch
- No Wireless Channel Available
- SNTP Synchronization Failed
- Wireless Link Disabled Warning
- Data Port Disabled Warning
- Data Port Status
- Data Port Fiber Status
- Ethernet Bridging Status
- Telecoms Channel A Status
- Telecoms Channel B Status
- Telecoms Channel A Loopback
- Telecoms Channel B Loopback
- TDD Synchronization Alarm
- Link Mode Optimization Mismatch
- Syslog Disabled Warning
- Syslog Local Nearly Full
- Syslog Local Wrapped
- Syslog Client Disabled Warning
- Secure Mode

The web-based interface may be used to enable or disable generation of each supported SNMP notification or diagnostic alarm.

Enabling SNMP

Enable the SNMP interface for use by configuring the following attributes in the Remote Management page:

- SNMP State (default disabled)
- SNMP Version (default SNMPv1/2c)
- SNMP Port Number (default 161)

When the SNMP Version is set to SNMPv1/2c the interface must be additionally configured by entering the following attributes:

- SNMP Trap IP Address
- SNMP Trap Port Number
- SNMP Community String

Planning for SNMPv3 operation

SNMP security mode

Decide how SNMPv3 security will be configured.

MIB-based security management uses standard SNMPv3 MIBs to configure the user-based security model and the view-based access control model. This approach provides considerable flexibility, allowing a network operator to tailor views and security levels appropriate for different types of user. MIB-based security management may allow a network operator to take advantage of built-in security management capabilities of existing network managers.

Web-based security management allows an operator to configure users, security levels, privacy and authentication protocols, and passphrases using the PTP 600 web-based management interface. The capabilities supported are somewhat less flexible than those supported using the MIB-based security management, but will be sufficient in many applications. Selection of web-based management for SNMPv3 security disables the MIB-based security management. PTP 600 does not support concurrent use of MIB-based and web-based management of SNMPv3 security.

Web-based management of SNMPv3 security

Initial configuration of SNMPv3 security is available only to HTTP or HTTPS/TLS user accounts with security role of Security Officer.

Identify the minimum security role of HTTP or HTTPS/TLS user accounts that will be permitted access for web-based management of SNMPv3 security. Two roles are available:

- System Administrator
- Security Officer

Identify the format used for SNMP Engine ID. Three formats are available:

- MAC address (default)
- IP address
- Text string

If SNMP Engine ID will be based on a text string, identify the text string required by the network management system. This is often based on some identifier that survives replacement of the PTP hardware.

Identify the user names and security roles of initial SNMPv3 users. Two security roles are available:

- Read Only
- System Administrator

Identify the security level for each of the security roles. Three security levels are available:

- No authentication, no privacy
- Authentication, no privacy
- Authentication, privacy

If authentication is required, identify the protocol. Two authentication protocols are available:

- MD5
- SHA

If privacy will be used, identify the protocol. Two privacy protocols are available:

- DES
- AES

AES link encryption is only available to users who have purchased an appropriate license key.

If authentication or authentication and privacy protocols are required, identify passphrases for each protocol for each SNMP user. It is considered good practice to use different passphrases for authentication and privacy. Passphrases must have length between 8 and 32 characters, and may contain any of the characters listed in Table 17.

Table 17 Permitted character set for SNMPv3 passphrases

Character	Code	Character	Code
<space>	32	;	59
!	33	<	60
“	34	=	61
#	35	>	62
$	36	?	63
%	37	@	64
&	38	A..Z	65..90
'	39	[	91
(	40	\	92
)	41	]	93
*	42	^	94
+	43	_	95
,	44	`	96
-	45	a..z	97..122
.	46	{	123
/	47	|	124
0..9	48..57	}	125
:	58	~	126

Identify up to two SNMP users that will be configured to receive notifications (traps). Identify the IP address and UDP port number of the associated SNMP manager.

SNMPv3 default configuration (MIB-based)

When SNMPv3 MIB-based Security Mode is enabled, the default configuration for the `usmUserTable` table is based on one initial user and four template users as listed in Table 18.

Table 18 Default SNMPv3 users

Object	Entry 1
Name	initial
SecurityName	initial
AuthProtocol	usmHMACMD5AuthProtocol
PrivProtocol	usmDESPrivProtocol
StorageType	nonVolatile

Object	Entry 2	Entry 3
Name	templateMD5_DES	templateSHA_DES
SecurityName	templateMD5_DES	templateSHA_DES
AuthProtocol	usmHMACMD5AuthProtocol	usmHMACSAHAuthProtocol
PrivProtocol	usmDESPrivProtocol	usmDESPrivProtocol
StorageType	nonVolatile	nonVolatile

Object	Entry 4	Entry 5
Name	templateMD5_AES	templateSHA_AES
SecurityName	templateMD5_AES	templateSHA_AES
AuthProtocol	usmHMACMD5AuthProtocol	usmHMACSHAAuthProtocol
PrivProtocol	usmAESPrivProtocol	usmAESPrivProtocol
StorageType	nonVolatile	nonVolatile

VACM default configuration

The default user `initial` is assigned to VACM group `initial` in the `vacmSecurityToGroupTable` table. The template users are not assigned to a group.

PTP 600 creates default view trees and access as shown in Table 19 and Table 20.

Table 19 Default VACM view trees

Object	Entry 1	Entry 2
ViewName	internet	restricted
Subtree	1.3.6.1	1.3.6.1
Mask	“”	“”
Type	included	included
StorageType	nonVolatile	nonVolatile

Table 20 Default data fill for access table

Object	Entry 1	Entry 2
GroupName	initial	initial
ContextPrefix	“”	“”
SecurityLevel	authNoPriv	noAuthNoPriv
ContextMatch	exact	exact
ReadViewName	internet	restricted
WriteViewName	internet	“”
NotifyViewName	internet	restricted
StorageType	nonVolatile	nonVolatile

Planning for RADIUS operation

Configure RADIUS where remote authentication is required for users of the web-based interface. Remote authentication has the following advantages:

- Control of passwords can be centralized.
- Management of user accounts can be more sophisticated For example, users can be prompted by email to change passwords at regular intervals. As another example, passwords can be checked for inclusion of dictionary words and phrases.
- Passwords can be updated without reconfiguring multiple network elements.
- User accounts can be disabled without reconfiguring multiple network elements.

Remote authentication has one significant disadvantage in a wireless link product such as PTP 600. If the wireless link is down, a unit on the remote side of the broken link may be prevented from contacting a RADIUS Server, with the result that users are unable to access the web-based interface.

One useful strategy would be to combine RADIUS authentication for normal operation with a single locally-authenticated user account for emergency use.

PTP 600 provides a choice of three authentication methods:

- CHAP
- MS-CHAPv2
- PEAP(MS-CHAPv2)

PEAP(MS-CHAPv2) is supported for Microsoft Windows Server 2003.

Ensure that the authentication method selected in PTP 600 is supported by the RADIUS server.

RADIUS is not permitted in FIPS 140-2 applications. RADIUS and PEAP(MS-CHAPv2) are mandatory in UC APL applications.

RADIUS attributes

If the standard RADIUS attribute session-timeout (Type 27) is present in a RADIUS response, PTP 600 sets a maximum session length for the authenticated user. If the attribute is absent, the maximum session length is infinite.

If the standard RADIUS attribute idle-timeout (Type 28) is present in a RADIUS response, PTP 600 overrides the Auto Logout Timer with this value in the authenticated session.

If the vendor-specific RADIUS attribute auth-role is present in a RADIUS response, PTP 600 selects the role for the authenticated user according to auth-role. The supported values of auth-role are as follows:

- 0: Invalid role. The user is not admitted.
- 1: Read Only
- 2: System Administrator
- 3: Security Officer

If the vendor-specific auth-role attribute is absent, but the standard service-type (Type 6) attribute is present, PTP 600 selects the role for the authenticated user according to service-type. The supported values of service-type are as follows:

- Login(1): Read Only
- Administrative(6): System Administrator
- NAS Prompt(7): Read Only

If the auth-role and service-type attributes are absent, PTP 600 selects the Read Only role.

The auth-role vendor-specific attribute is defined in Table 21.

Table 21 Definition of auth-role vendor-specific attribute

Field	Length	Value	Notes
Type	1	26	Vendor-specific attribute.
Length	1	12	Overall length of the attribute.
Vendor ID	4	17713	The same IANA code used for the SNMP enterprise MIB.
Vendor Type	1	1	auth-role
Vendor Length	1	4	Length of the attribute specific part.
Attribute-Specific	4	0..3	Integer type (32-bit unsigned). Supported values: invalid-role(0), readonly-role(1), system-admin-role(2), security-officer-role(3).

Ordering components

This section describes describes how to select components for a planned PTP 600 link (as an alternative to PTP LINKPlanner). It specifies Cambium part numbers for PTP 600 components.

PTP 600 kits

The PTP 600 is supplied as a 'Link' or an 'End' kit. A ‘Link’ kit contains components for both ends of a link (including two ODUs and two PIDU units). An 'End' kit contains components for one end of a link (including one ODU and one PIDU unit). The kits may contain either integrated ODUs (antennas included) or connectorized ODUs (separate antennas must be purchased).

PTP 54600 and PTP 58600 variants

PTP 54600 and PTP 58600 kits are supplied in two regional variants: one is for use in regions where FCC or IC licensing restrictions apply (FCC/IC), and the other is for use in ETSI countries or the rest of the world (ETSI/RoW).

Table 22 and Table 23 indicate which PTP 54600 and PTP 58600 product variants may be deployed in each regulatory region.

Table 22 PTP 54600 product variants available in each regulation

Regulation	Lite and Full		ATEX / Hazloc		OOBM
	ETSI / RoW	FCC / IC	ETSI / RoW	FCC / IC	
Australia	Yes				
Canada		Yes		Yes	
ETSI	Yes		Yes		
FCC		Yes		Yes	
Full Power	Yes				
Full Power + Radar	Yes				
Korea	Yes				
Mexico					Yes
Thailand	Yes				

Table 23 PTP 58600 product variants available in each regulation

Regulation	Lite and Full		ATEX / Hazloc		OOBM
	ETSI / RoW	FCC / IC	ETSI / RoW	FCC / IC	
Australia	Yes				
Bahrain	Yes				
Brazil	Yes				
Canada		Yes			
China	Yes				
Denmark	Yes		Yes		
ETSI	Yes		Yes		
Eire	Yes		Yes		
FCC		Yes		Yes	
Full Power	Yes		Yes		
Germany	Yes		Yes		
Hong Kong	Yes				
India	Yes				
Korea	Yes				
Mexico					Yes
Norway	Yes				
Singapore	Yes				
Spain	Yes		Yes		
Taiwan	Yes				
Thailand	Yes				
UK	Yes		Yes		

Kit part numbers

The following tables contain part numbers for all kit variants:

- Table 24: PTP 25600
- Table 25: PTP 45600
- Table 26: PTP 48600
- Table 27: PTP 49600
- Table 28: PTP 54600
- Table 29: PTP 58600
- Table 30: PTP 59600

NOTE

PTP 54600 and PTP 58600 units manufactured before the introduction of regional variants have the same part numbers as corresponding ETSI/RoW units, but are identified by an earlier part number suffix.

Table 24 PTP 25600 kit part numbers

Integrated or connectorized	Link or end complete	Part number
Integrated	Link Complete	WB2782
Integrated	End Complete	WB2784
Connectorized	Link Complete	WB2783
Connectorized	End Complete	WB2785

Table 25 PTP 45600 kit part numbers

Integrated or connectorized	Link or end complete	Part number
Integrated	Link Complete	WB3040
Integrated	End Complete	WB3041
Connectorized	Link Complete	WB3044
Connectorized	End Complete	WB3045

Table 26 PTP 48600 kit part numbers

Integrated or connectorized	Link or end complete	Part number
Integrated	Link Complete	WB3378
Integrated	End Complete	WB3379
Connectorized	Link Complete	WB3382
Connectorized	End Complete	WB3383

Table 27 PTP 49600 kit part numbers

Integrated or connectorized	Link or end complete	Part number
Integrated	Link Complete	WB3225
Integrated	End Complete	WB3229
Connectorized	Link Complete	WB3226
Connectorized	End Complete	WB3230

Table 28 PTP 54600 kit part numbers

Product variant	Regional variant	Integrated or connectorized	Link or end complete	Part number
Lite	ETSI/RoW	Integrated	Link Complete	BP5530BH15-2
Lite	ETSI/RoW	Integrated	End Complete	BP5530BH15-1
Lite	ETSI/RoW	Connectorized	Link Complete	BP5530BHC15-2
Lite	ETSI/RoW	Connectorized	End Complete	BP5530BHC15-1
Lite	FCC/IC	Integrated	Link Complete	WB3870
Lite	FCC/IC	Integrated	End Complete	WB3871
Lite	FCC/IC	Connectorized	Link Complete	WB3874
Lite	FCC/IC	Connectorized	End Complete	WB3875
Full	ETSI/RoW	Integrated	Link Complete	BP5530BH–2
Full	ETSI/RoW	Integrated	End Complete	BP5530BH–1
Full	ETSI/RoW	Connectorized	Link Complete	BP5530BHC–2
Full	ETSI/RoW	Connectorized	End Complete	BP5530BHC–1
Full	FCC/IC	Integrated	Link Complete	WB3868

Product variant	Regional variant	Integrated or connectorized	Link or end complete	Part number
Full	FCC/IC	Integrated	End Complete	WB3869
Full	FCC/IC	Connectorized	Link Complete	WB3872
Full	FCC/IC	Connectorized	End Complete	WB3873
OOBM	-	Integrated	Link Complete	WB3768
OOBM	-	Integrated	End Complete	WB3769
OOBM	-	Connectorized	Link Complete	WB3770
OOBM	-	Connectorized	End Complete	WB3771
ATEX/Hazloc	ETSI/RoW	Integrated	Link Complete	WB3820
ATEX/Hazloc	ETSI/RoW	Integrated	End Complete	WB3821
ATEX/Hazloc	ETSI/RoW	Connectorized	Link Complete	WB3822
ATEX/Hazloc	ETSI/RoW	Connectorized	End Complete	WB3823
ATEX/Hazloc	FCC/IC	Integrated	Link Complete	WB3788
ATEX/Hazloc	FCC/IC	Integrated	End Complete	WB3789
ATEX/Hazloc	FCC/IC	Connectorized	Link Complete	WB3790
ATEX/Hazloc	FCC/IC	Connectorized	End Complete	WB3791

Table 29 PTP 58600 kit part numbers

Product variant	Regional variant	Integrated or connectorized	Link or end complete	Part number
Lite	ETSI/RoW	Integrated	Link Complete	BP5830BH15–2
Lite	ETSI/RoW	Integrated	End Complete	BP5830BH15–1
Lite	ETSI/RoW	Connectorized	Link Complete	BP5830BHC15–2
Lite	ETSI/RoW	Connectorized	End Complete	BP5830BHC15–1
Lite	FCC/IC	Integrated	Link Complete	WB3862
Lite	FCC/IC	Integrated	End Complete	WB3863
Lite	FCC/IC	Connectorized	Link Complete	WB3866
Lite	FCC/IC	Connectorized	End Complete	WB3867
Full	ETSI/RoW	Integrated	Link Complete	BP5830BH–2
Full	ETSI/RoW	Integrated	End Complete	BP5830BH–1
Full	ETSI/RoW	Connectorized	Link Complete	BP5830BHC–2

Product variant	Regional variant	Integrated or connectorized	Link or end complete	Part number
Full	ETSI/RoW	Connectorized	End Complete	BP5830BHC–1
Full	FCC/IC	Integrated	Link Complete	WB3860
Full	FCC/IC	Integrated	End Complete	WB3861
Full	FCC/IC	Connectorized	Link Complete	WB3864
Full	FCC/IC	Connectorized	End Complete	WB3865
OOBM	-	Integrated	Link Complete	WB3764
OOBM	-	Integrated	End Complete	WB3765
OOBM	-	Connectorized	Link Complete	WB3766
OOBM	-	Connectorized	End Complete	WB3767
ATEX/Hazloc	ETSI/RoW	Integrated	Link Complete	WB3816
ATEX/Hazloc	ETSI/RoW	Integrated	End Complete	WB3817
ATEX/Hazloc	ETSI/RoW	Connectorized	Link Complete	WB3818
ATEX/Hazloc	ETSI/RoW	Connectorized	End Complete	WB3819
ATEX/Hazloc	FCC/IC	Integrated	Link Complete	WB3784
ATEX/Hazloc	FCC/IC	Integrated	End Complete	WB3785
ATEX/Hazloc	FCC/IC	Connectorized	Link Complete	WB3786
ATEX/Hazloc	FCC/IC	Connectorized	End Complete	WB3787

Table 30 PTP 59600 kit part numbers

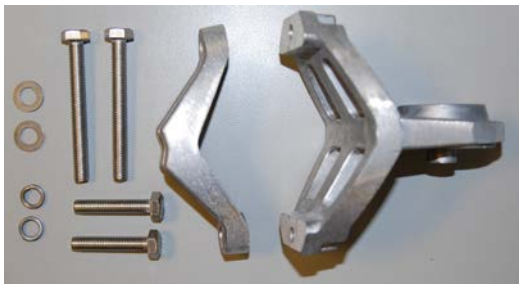
Integrated or connectorized	Link or end complete	Part number
Integrated	Link Complete	WB3097
Integrated	End Complete	WB3102
Connectorized	Link Complete	WB3098
Connectorized	End Complete	WB3103

Kit inventory

Table 31 lists PTP 600 kit components.

Table 31 Inventory for PTP 600 kits

Item	Notes
ODUs	ODUs may be Integrated (as illustrated) or Connectorized. 'End Complete' kit contains one ODU with grounding cable. 'Link Complete' kit contains two ODUs with grounding cables.
PIDU	'End Complete' kit contains one PIDU unit. 'Link Complete' kit contains two PIDU units.

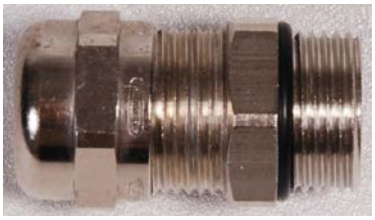
Item	Notes
Mounting bracket assembly 	‘End Complete’ kit contains one bracket. ‘Link Complete’ kit contains two brackets.
Choice of mains leads (US, UK and EU)	‘End Complete’ kit contains one US, one UK and one EU lead. ‘Link Complete’ kit contains two US, two UK and two EU leads.
Cable gland	‘End Complete’ kit contains two glands. ‘Link Complete’ kit contains four glands.

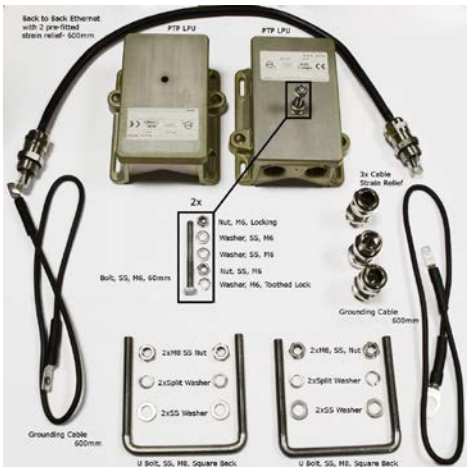
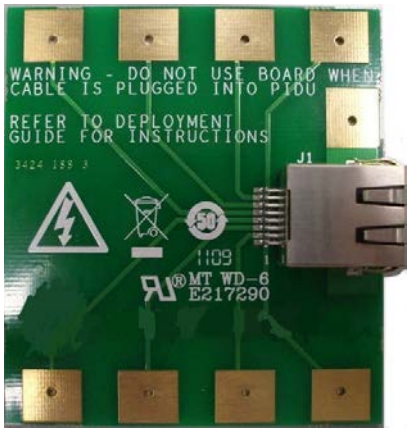
Other standard components

In addition to ODU and PIDU kits, standard installations require the components listed in Table 32.

Table 32 Inventory for standard installations

Item	Notes
Outdoor drop cable **⚠ CAUTION** Always use Cat5e cable that is gel-filled and shielded with copper-plated steel. Alternative types of drop cable are not supported by Cambium.	Superior Essex BBDGe cable is supplied by Cambium with the following lengths and part numbers (other lengths are available from Superior Essex): ‘1000 ft Reel Outdoor Copper Clad CAT5E’. Cambium part number WB3175. ‘328 ft (100 m) Reel Outdoor Copper Clad CAT5E’. Cambium part number WB3176.

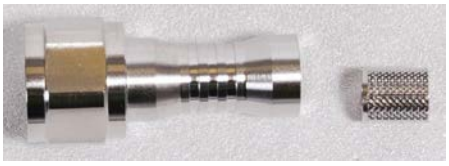
Item	Notes
RJ45 connectors **NOTE** The specified connectors and crimp tool are specific to Superior Essex BBDGe cable (they may not work with other types of cable).	'Tyco/AMP, Mod Plug RJ45 Unscreened, 25 pk'. Cambium part number WB3177. 'Tyco/AMP Crimp Tool'. Cambium part number WB3211.
Cable glands 	For protecting the drop cable entry points. Glands are included in the ODU and LPU kits, but additional glands may be purchased from Cambium if required. 'PTP SER EMC CABLE GLAND (GROUNDING)'. Quantity 10. Cambium, part number WB1811.
Cable hoisting grip 	For hoisting the drop cable up to the ODU without damaging the gland or RJ45 plug. Not supplied by Cambium.
Cable grounding kits 	One kit is required per drop cable grounding point. 'Cable Grounding Kits For 1/4" And 3/8" Cable'. Cambium part number 01010419001. Kit contents: grounding cable, self-amalgamating tape, PVC tape, tie-wraps, bolts, washers and nuts.

Item	Notes
Lightning Protection Unit (LPU) kit 	Two kits are required per standard link (total four LPUs). For installations not in hazardous locations, use: 'LPU End Kit PTP600'. Cambium part number WB2907D. For installations in hazardous locations, use: 'LPU End Kit PTP400/600 Atex/Hazloc Compliant'. Cambium part number WB3938A. Kit contents: two LPUs, grounding cables, 600mm ODU to LPU cable, nuts, bolts and glands.
Cable ties, cable cleats.	For securing cables. Purchase separately.
Indoor Cat5e cable **⚠ CAUTION** The connected network equipment must feature screened RJ45 connectors and must be connected to ground, otherwise the PIDU will not be grounded.	To connect the PIDU to network equipment, use screened cable that meets this specification: **Screening**: Must be either foil screen (FTP) or braided screen (STP) cable. **Connectors**: Must use screened RJ45 connectors with metal shells at both ends. **Electrical connection**: There must be a continuous electrical connection between both screened connectors.
Drop cable tester 	An optional item for testing the resistances between the RJ45 pins of the drop cable. Order from the support website (see Contacting Cambium Networks on page 2) by completing the order form.

Components required with connectorized ODUs

Connectorized ODUs require the additional components listed in Table 33.

Table 33 Additional inventory for connectorized ODUs

Item	Notes
Antenna	One required per link end (or two per link end for spatial diversity). Not supplied by Cambium. For connectorized units operating in the USA or Canada, choose external antennas from those listed in FCC and IC approved antennas on page 2-64.
RF cable	For connecting the ODU to the antenna. May be cable of type LMR100, LMR200, LMR300, LMR400 or LMR600. LMR400 is supplied by Cambium: '50 Ohm Braided Coaxial Cable - 75 meter'. Cambium part number 30010194001. '50 Ohm Braided Coaxial Cable - 500 meter'. Cambium part number 30010195001.
N type male connectors 	For connecting the RF cables to the ODU. Two connectors required per ODU. Use weatherproof connectors, preferably ones that are supplied with adhesive lined heat shrink sleeves that are fitted over the cable/connector interface. 'RF CONNECTOR,N,MALE,STRAIGHT FOR CNT-400 CABLE'. Cambium part number 09010091001. **NOTE** For the antenna end of the RF cable, refer to the antenna manufacturer's instructions.
Self-amalgamating and PVC tape	To weatherproof the RF connectors.
Cable grounding kits	One kit is required per antenna cable grounding point. Refer to Table 32 for specifications and part numbers.
Lightning arrestor	For protecting the antenna cable at building entry, when the ODU is mounted indoors. One required per antenna cable. For example: Polyphaser LSXL-ME or LSXL.

FCC and IC approved antennas

For connectorized units operating in the USA or Canada, choose external antennas from Table 34 (5.4 GHz) or Table 35 and Table 36 (5.8 GHz). These are approved by the FCC for use with the product and are constrained by the following limits for single- or dual-polarization parabolic dish antennas:

- 5.4 GHz - 34.9 dBi (33.4 dBi for 5 MHz bandwidth) per polarization or antenna.
- 5.8 GHz - up to 37.7 dBi per polarization or antenna.

⚠ CAUTION

Antennas not included in these tables are strictly prohibited for use with the PTP 600 in the specified bands.

⚠ CAUTION

This radio transmitter (IC certification number 109AO-5X250) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Le présent émetteur radio (Numéro de certification IC 109AO-5X250) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

Table 34 Allowed antennas for deployment in USA/Canada – 5.4 GHz

Manufacturer	Antenna Type	Gain (dBi)	Parabolic Dish
Andrew	Andrew 2-foot Parabolic, P2F-52 (29.4dBi)	29.4	Y
Andrew	Andrew 2-foot Dual-Pol Parabolic, PX2F-52 (29.4dBi)	29.4	Y
Andrew	Andrew 3-foot Parabolic, P3F-52 (33.4dBi)	33.4	Y
Andrew	Andrew 3-foot Dual-Pol Parabolic, PX3F-52 (33.4dBi)	33.4	Y
Andrew	Andrew 4-foot Parabolic, P4F-52 (34.9dBi)	34.9	Y
Andrew	Andrew 4-foot Dual-Pol Parabolic, PX4F-52 (34.9dBi)	34.9	Y

Manufacturer	Antenna Type	Gain (dBi)	Parabolic Dish
Gabriel	Gabriel 2-foot High Performance QuickFire Parabolic, HQF2-52-N	28.2	Y
Gabriel	Gabriel 4-foot High Performance QuickFire Parabolic, HQF4-52-N	34.4	Y
Gabriel	Gabriel 2-foot High Performance Dual QuickFire Parabolic, HQFD2-52-N	28.1	Y
Gabriel	Gabriel 4-foot High Performance Dual QuickFire Parabolic, HQFD4-52-N	34.3	Y
Gabriel	Gabriel 2-foot Standard QuickFire Parabolic, QF2-52-N	28.5	Y
Gabriel	Gabriel 2-foot Standard QuickFire Parabolic, QF2-52-N-RK	28.5	Y
Gabriel	Gabriel 2.5-foot Standard QuickFire Parabolic, QF2.5-52-N	31.2	Y
Gabriel	Gabriel 4-foot Standard QuickFire Parabolic, QF4-52-N	34.8	Y
Gabriel	Gabriel 4-foot Standard QuickFire Parabolic, QF4-52-N-RK	34.8	Y
Gabriel	Gabriel 2-foot Standard Dual QuickFire Parabolic, QFD2-52-N	28.4	Y
Gabriel	Gabriel 2.5-foot Standard Dual QuickFire Parabolic, QFD2.5-52-N	31.1	Y
Gabriel	Gabriel 2-foot Standard Dual QuickFire Parabolic, QFD2-52-N-RK	28.4	Y
Gabriel	Gabriel 4-foot Standard Dual QuickFire Parabolic, QFD4-52-N	34.7	Y
Gabriel	Gabriel 4-foot Standard Dual QuickFire Parabolic, QFD4-52-N-RK	34.7	Y
RadioWaves	Radio Waves 2-foot Dual-Pol Parabolic, SPD2-5.2 (28.1dBi)	28.1	Y
RadioWaves	Radio Waves 2-foot Parabolic, SP2-5.2 (29.0dBi)	29	Y
RadioWaves	Radio Waves 3-foot Dual-Pol Parabolic, SPD3-5.2 (31.1dBi)	31.1	Y

Manufacturer	Antenna Type	Gain (dBi)	Parabolic Dish
RadioWaves	Radio Waves 3-foot Parabolic, SP3-5.2 (31.4dBi)	31.4	Y
RadioWaves	Radio Waves 4-foot Dual-Pol Parabolic, SPD4-5.2 (34.4dBi)	34.4	Y
RadioWaves	Radio Waves 4-foot Parabolic, SP4-5.2 (34.8dBi)	34.8	Y
RadioWaves	Radio Waves 2-foot Parabolic, SP2-2/5 (28.3dBi)	28.3	Y
RadioWaves	Radio Waves 3-foot Parabolic, SP3-2/5 (31.4dBi)	31.4	Y
RadioWaves	Radio Waves 4-foot Parabolic, SP4-2/5 (34.6dBi)	34.6	Y
RFS	RFS 2-foot Parabolic, SPF2-52AN or SPFX2-52AN (27.9dBi)	27.9	Y
RFS	RFS 3-foot Parabolic, SPF3-52AN or SPFX3-52AN(31.4dBi)	31.4	Y
RFS	RFS 4-foot Parabolic, SPF4-52AN or SPFX4-52AN(33.9dBi)	33.9	Y
RFS	RFS 2-foot HP Parabolic, SDF2-52AN or SDFX2-52AN (31.4dBi)	31.4	Y
RFS	RFS 4-foot HP Parabolic, SDF4-52AN or SDFX4-52AN (33.9dBi)	33.9	Y

Table 35 Allowed antennas for deployment in USA/Canada – 5.8 GHz

Manufacturer	Antenna Type	Gain (dBi)	Flat Plate	Parabolic Dish
Andrew	Andrew 1-foot Flat Panel, FPA5250D12-N (23.6dBi)	23.6	Y	
Andrew	Andrew 2-foot Flat Panel, FPA5250D24-N (28dBi)	28	Y	
Gabriel	Gabriel 1-foot Flat Panel, DFPD1-52 (23.5dBi)	23.5	Y	
Gabriel	Gabriel 2-foot Flat Panel, DFPD2-52 (28dBi)	28	Y	

Manufacturer	Antenna Type	Gain (dBi)	Flat Plate	Parabolic Dish
MTI	MTI 17 inch Diamond Flat Panel, MT-485009 (23dBi)	23	Y	
MTI	MTI 15 inch Dual-Pol Flat Panel, MT-485025/NVH (23dBi)	23	Y	
MTI	MTI 2 ft Directional Flat Panel, MT-20004 (28dBi)	28	Y	
MTI	MTI 2 ft Flat Panel, MT-486001 (28dBi)	28	Y	
RFS	RFS 1-foot Flat Panel, MA0528-23AN (23dBi)	23	Y	
RFS	RFS 2-foot Flat Panel, MA0528-28AN (28dBi)	28	Y	
Telectronics	Teletronics 2-foot Flat Plate Antenna, ANT-P5828 (28dBi)	28	Y	
Andrew	Andrew 2-foot Parabolic, P2F-52 (29.4dBi)	29.4		Y
Andrew	Andrew 2-foot Dual-Pol Parabolic, PX2F-52 (29.4dBi)	29.4		Y
Andrew	Andrew 3-foot Parabolic, P3F-52 (33.4dBi)	33.4		Y
Andrew	Andrew 3-foot Dual-Pol Parabolic, PX3F-52 (33.4dBi)	33.4		Y
Andrew	Andrew 4-foot Parabolic, P4F-52 (34.9dBi)	34.9		Y
Andrew	Andrew 4-foot Dual-Pol Parabolic, PX4F-52 (34.9dBi)	34.9		Y
Andrew	Andrew 6-foot Parabolic, P6F-52 (37.6dBi)	37.6		Y
Andrew	Andrew 6-foot Dual-Pol Parabolic, PX6F-52 (37.6dBi)	37.6		Y
Gabriel	Gabriel 2-foot High Performance QuickFire Parabolic, HQF2-52-N	28.2		Y
Gabriel	Gabriel 4-foot High Performance QuickFire Parabolic, HQF4-52-N	34.4		Y
Gabriel	Gabriel 6-foot High Performance QuickFire Parabolic, HQF6-52-N	37.4		Y

Manufacturer	Antenna Type	Gain (dBi)	Flat Plate	Parabolic Dish
Gabriel	Gabriel 2-foot High Performance Dual QuickFire Parabolic, HQFD2-52-N	28.1		Y
Gabriel	Gabriel 4-foot High Performance Dual QuickFire Parabolic, HQFD4-52-N	34.3		Y
Gabriel	Gabriel 6-foot High Performance Dual QuickFire Parabolic, HQFD6-52-N	37.3		Y
Gabriel	Gabriel 2-foot Standard QuickFire Parabolic, QF2-52-N	28.5		Y
Gabriel	Gabriel 2-foot Standard QuickFire Parabolic, QF2-52-N-RK	28.5		Y
Gabriel	Gabriel 2.5-foot Standard QuickFire Parabolic, QF2.5-52-N	31.2		Y
Gabriel	Gabriel 4-foot Standard QuickFire Parabolic, QF4-52-N	34.8		Y
Gabriel	Gabriel 4-foot Standard QuickFire Parabolic, QF4-52-N-RK	34.8		Y
Gabriel	Gabriel 6-foot Standard QuickFire Parabolic, QF6-52-N	37.7		Y
Gabriel	Gabriel 2-foot Standard Dual QuickFire Parabolic, QFD2-52-N	28.4		Y
Gabriel	Gabriel 2.5-foot Standard Dual QuickFire Parabolic, QFD2.5-52-N	31.1		Y
Gabriel	Gabriel 2-foot Standard Dual QuickFire Parabolic, QFD2-52-N-RK	28.4		Y
Gabriel	Gabriel 4-foot Standard Dual QuickFire Parabolic, QFD4-52-N	34.7		Y
Gabriel	Gabriel 4-foot Standard Dual QuickFire Parabolic, QFD4-52-N-RK	34.7		Y
Gabriel	Gabriel 6-foot Standard Dual QuickFire Parabolic, QFD6-52-N	37.7		Y

Manufacturer	Antenna Type	Gain (dBi)	Flat Plate	Parabolic Dish
RadioWaves	Radio Waves 2-foot Dual-Pol Parabolic, SPD2-5.2 (28.1dBi)	28.1		Y
RadioWaves	Radio Waves 2-foot Parabolic, SP2-5.2 (29.0dBi)	29		Y
RadioWaves	Radio Waves 3-foot Dual-Pol Parabolic, SPD3-5.2 (31.1dBi)	31.1		Y
RadioWaves	Radio Waves 3-foot Parabolic, SP3-5.2 (31.4dBi)	31.4		Y
RadioWaves	Radio Waves 4-foot Dual-Pol Parabolic, SPD4-5.2 (34.4dBi)	34.4		Y
RadioWaves	Radio Waves 4-foot Parabolic, SP4-5.2 (34.8dBi)	34.8		Y
RadioWaves	Radio Waves 6-foot Dual-Pol Parabolic, SPD6-5.2 (37.5dBi)	37.5		Y
RadioWaves	Radio Waves 6-foot Parabolic, SP6-5.2 (37.7dBi)	37.7		Y
RadioWaves	Radio Waves 2-foot Parabolic, SP2-2/5 (28.3dBi)	28.3		Y
RadioWaves	Radio Waves 3-foot Parabolic, SP3-2/5 (31.4dBi)	31.4		Y
RadioWaves	Radio Waves 4-foot Parabolic, SP4-2/5 (34.6dBi)	34.6		Y
RadioWaves	Radio Waves 6-foot Parabolic, SP6-2/5 (37.7dBi)	37.7		Y
RFS	RFS 2-foot Parabolic, SPF2-52AN or SPFX2-52AN (27.9dBi)	27.9		Y
RFS	RFS 3-foot Parabolic, SPF3-52AN or SPFX3-52AN(31.4dBi)	31.4		Y
RFS	RFS 4-foot Parabolic, SPF4-52AN or SPFX4-52AN(33.9dBi)	33.9		Y
RFS	RFS 6-foot Parabolic, SPF6-52AN or SPFX6-52AN (37.4dBi)	37.4		Y
RFS	RFS 2-foot HP Parabolic, SDF2-52AN or SDFX2-52AN (31.4dBi)	31.4		Y

Manufacturer	Antenna Type	Gain (dBi)	Flat Plate	Parabolic Dish
RFS	RFS 4-foot HP Parabolic, SDF4-52AN or SDFX4-52AN (33.9dBi)	33.9		Y
RFS	RFS 6-foot HP Parabolic, SDF6-52AN or SDFX6-52AN (37.4dBi)	37.4		Y
StellaDoradus	StellaDoradus 45 inch Parabolic Antenna, 58PSD113	33.8		Y

Table 36 Sectored antennas for deployment in USA/Canada – 5.8 GHz

Manufacturer	Antenna Type	Gain (dBi)	Beamwidth
RadioWaves	SEC-55V-60-17 SEC-55H-60-17 SEC-55D-60-17	17	60°
RadioWaves	SEC-55V-90-16 SEC-55H-90-16 SEC-55D-90-16	16	90°

UltraSync installations

UltraSync installations require the components listed in Table 37.

Table 37 Additional inventory for UltraSync installations

Item	Motes
UltraSync kit	'Memorylink UltraSync GPS 100M for PTP 600'. Cambium part number WB3001. The kit contains the following components: GPS synchronization unit. Three attached terminated Ethernet and sync cables and cable glands. Mounting bracket and mounting bracket bolts. Outdoor rated UV resistant cable tie. UltraSync user manual.

PTP-SYNC installations

PTP-SYNC installations require the additional components listed in Table 38.

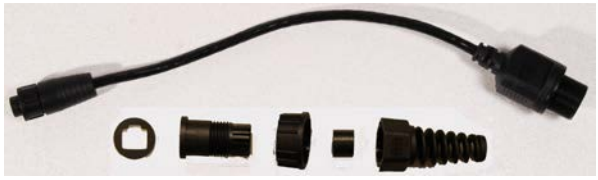
Table 38 Additional inventory for PTP-SYNC installations

Item	Notes
PTP-SYNC kit 	'PTP-SYNC'. Cambium part number WB3665. Kit contents: 1 x PTP-SYNC unit 1 x M4 pan screw 2 x M4 washers 2 x M3 (6mm) torx drive screws 1 x lug for unit ground (cable not supplied) 1 x Cat5e cable (length 1 meter) Installation guide
PTP-SYNC rack mount 	Required for rack-mounted PTP-SYNC units. 'PTP800 CMU / PTP-SYNC 19" rack mount installation kit'. Cambium part number WB3486. Kit contents: 1 x rack bracket 8 x M3 washers 8 x M3 screws 1 x rack mount blank plate 8 x M5 nuts 8 x M5 washers 2 x rack handles
Cat5e cable	This is only required if the 1 meter Cat5e cable supplied with the PTP-SYNC kit is not long enough. It may be up to 2 meters long.

GPS receiver installations

GPS receiver installations (for PTP-SYNC) require the components listed in Table 39.

Table 39 Additional inventory for GPS receiver installations

Item	Notes
GPS receiver	'Trimble Acutime™ Gold GPS receiver'. Cambium part number WB3903.
GPS adapter cable kit (optional) 	Avoids the need to fit a 12 way circular connector to the GPS drop cable. 'PTP-SYNC <-> Trimble Adapter Cable'. Cambium part number WB3961. Kit contents: adapter cable (GPS receiver circular connector to RJ45 socket), RJ45 plug housing.
Outdoor drop cable	Refer to Table 32 for specifications and part numbers.
RJ45 connectors	Refer to Table 32 for specifications and part numbers.
Cable grounding kits	Refer to Table 32 for specifications and part numbers.
Lightning Protection Unit (LPU) kits	One kit is required per GPS receiver. 'LPU End Kit PTP 250/300/500'. Cambium part number WB2978D. Kit contents: LPU, grounding cable, nuts, bolts and cable glands.

As an alternative to the GPS adapter cable, the drop cable can be connected directly to the GPS unit via a 12 way circular connector, using the components and tools listed in Table 40. This connection requires soldering.

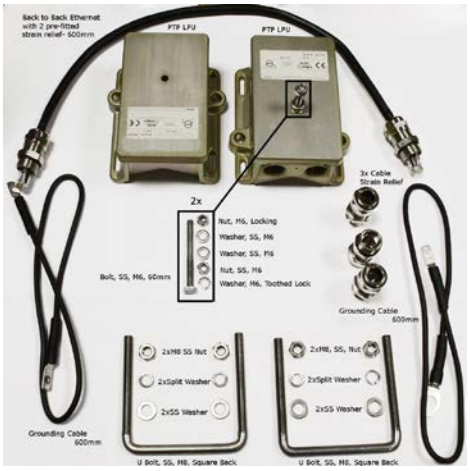
Table 40 Recommended outdoor connectors for Trimble GPS receiver

Item	Manufacturer	Part number
12 way circular connector	Deutsch	IMC26-2212X
Size 22 crimp socket	Deutsch	6862-201-22278
Crimp tool	Daniels Manufacturing Corp	MH860
Positioner	Daniels Manufacturing Corp	86-5
Insertion / extraction tool	Deutsch	6757-201-2201
Adaptor	Deutsch	IMC2AD
Self amalgamating tape		

E1 or T1 installations

E1 or T1 installations require the components listed in Table 41.

Table 41 Additional inventory for E1 or T1 or OOBM installations

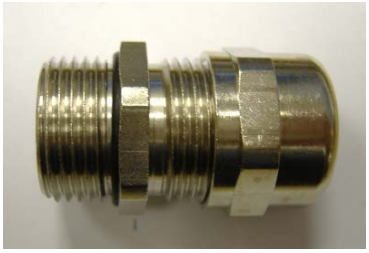
Item	Notes
Outdoor drop cable	Refer to Table 32 for specifications and part numbers.
RJ45 connectors	Refer to Table 32 for specifications and part numbers.
Cable grounding kits	Refer to Table 32 for specifications and part numbers.
Lightning Protection Unit (LPU) kit 	One kit is required per E1 or T1 link (total two LPUs). For installations not in hazardous locations, use: ‘LPU End Kit PTP600’. Cambium part number WB2907D. For installations in hazardous locations, use: ‘LPU End Kit PTP400/600 Atex/Hazloc Compliant’. Cambium part number WB3938A. Kit contents: two LPUs, grounding cables, 600mm ODU to LPU cable, nuts, bolts and glands.

Item	Notes
Telecoms network cable	Purchase separately.

Fiber installations

Fiber optic installations require the additional components listed in Table 42.

Table 42 Additional inventory for fiber installations

Item	Notes
PTP 600 fiber upgrade kit Either 1000BaseSX: Or 1000BaseLX: Extension tube: Weatherproofing gland: 	Either: 'SFP SX Gig-E Optical Pluggable Module - 850 nm'. Cambium part number 01010430001. Or: 'SFP LX Gig-E Optical Pluggable Module - 1310 nm'. Cambium part number 01010431001. Kit contents: SFP fiber module (either 1000BaseSX or 1000BaseLX) Extension tube (complete with 'O' ring seal) Weatherproofing gland License key instructions and ID code
Fiber optic cable and connectors	Purchase separately. For specification, refer to Fiber optic cable and connectors on page 4-8.

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USB library functions

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Chapter 4: Reference information

This chapter contains reference information and regulatory notices that apply to the PTP 600 Series products.

The following topics are described in this chapter:

- Equipment specifications on page 4-2 contains specifications of the ODU, PIDU and other equipment required for PTP 600 installations.
- Wireless specifications on page 4-9 contains specifications of the PTP 600 wireless interface, including RF bands, channel width and link loss.
- Data network specifications on page 4-46 contains specifications of the PTP 600 Ethernet interface.
- Syslog message formats on page 4-48 describes the format and content of Syslog event messages.
- Compliance with safety standards on page 4-51 lists the safety specifications against which the PTP 600 has been tested and certified. It also describes how to keep RF exposure within safe limits.
- Compliance with radio regulations on page 4-58 describes how the PTP 600 complies with the radio regulations that are in force in various countries.
- Notifications on page 4-67 contains notifications made to regulatory bodies for the PTP 600.
- Data throughput tables on page 4-74 contains tables and graphs to support calculation of the data rate capacity that can be provided by PTP 600 configurations.

Equipment specifications

This section contains specifications of the ODU, PIDU and other equipment required for PTP 600 installations.

ODU specifications

The PTP 600 ODU conforms to the specifications listed in Table 43, Table 44 and Table 45. These specifications apply to all PTP 600 product variants.

Table 43 Integrated ODU physical specifications

Category	Specification
Dimensions	Width 370 mm (14.5 in), Height 370 mm (14.5 in), Depth 95 mm (3.75 in)
Weight	5.5 Kg (12.1 lbs) including bracket

Table 44 Connectorized ODU physical specifications

Category	Specification
Dimensions	Width 305 mm (12 in), Height 305 mm (12 in), Depth 105 mm (4.01 in)
Weight	4.3 Kg (9.1 lbs) including bracket

Table 45 ODU environmental specifications

Category	Specification
Temperature	-40°C (-40°F) to +60°C (140°F)
Wind loading	150 mph (242 kph) maximum. See Wind loading on page 2-9 for a full description.
Humidity	100% condensing
Waterproofing	IP66
UV exposure	10 year operational life (UL746C test evidence)

PIDU specifications

The PTP 600 PIDU conforms to the specifications listed in Table 46, Table 47 and Table 48. These specifications apply to all PTP 600 product variants.

Table 46 PIDU physical specifications

Category	Specification
Dimensions	Width 250 mm (9.75 in), Height 40 mm (1.5 in), Depth 80 mm (3 in)
Weight	0.864 Kg (1.9 lbs)

Table 47 PIDU environmental specifications

Category	Specification
Temperature	-40°C (-40°F) to +60°C (140°F)
Humidity	0 to 95% non-condensing
Waterproofing	Not waterproof

Table 48 PIDU electrical specifications

Category	Specification
AC Input	90 – 264 V AC, 47 – 60 Hz
Alternative DC Input	37 – 60 V DC
DC Output Voltage	For mains input: 55 V, +2V, -0V For DC input: Output voltage at maximum rated output current, not more than 1.5 V below the DC input voltage
AC Input connector	IEC 320-C8, (figure of eight)
DC Output current	1.4A
Efficiency	Better than 84%
Over Current Protection	Hiccup current limiting, trip point set between 120% to 150% of full load current
Hold up time	At least 20 milliseconds

PTP-SYNC specifications

The PTP-SYNC unit conforms to the specifications listed in Table 49, Table 50 and Table 51.

Table 49 PTP-SYNC unit physical specifications

Category	Specification
Dimensions	Width excluding ears 174 mm (6.69 in) Width including ears 196 mm (7.54 in) Height 31.5 mm (1.21 in) Depth 79 mm (3.04 in)
Weight	0.485 Kg (1.1 lbs)

Table 50 PTP-SYNC unit environmental specifications

Category	Specification
Temperature	-40°C (-40°F) to +60°C (140°F) Suitable for use indoors, or outdoors within a weatherproofed cabinet.
Humidity	0 to 95% non-condensing
Waterproofing	Not waterproof

Table 51 PTP-SYNC unit electrical specifications

Category	Specification
Power supply	Integrated with PIDU
Power consumption	1.5 W max (extra power is required to supply a GPS receiver)

There are two timing inputs to the PTP-SYNC unit: GPS/SYNC IN (RJ-45) (Table 52) and 1PPS IN (SMA) (Table 53).

Table 52 PTP-SYNC unit timing specifications - GPS/SYNC IN (RJ-45)

Category	Specification
Signal type	Differential 1 Hz signal
Common mode range	–7 V to +7 V, relative to GPS/SYNC IN pin 2 (ground)
Maximum differential voltage	±5 V
Threshold	±0.4 V
Impedance	90 ohms to 110 ohms
Pulse width	1 μs to 500 ms
Polarity	Reference edge is when pin 3 (PPSA) is positive with respect to pin 6 (PPSB)

Table 53 PTP-SYNC unit timing specifications - 1PPS IN (SMA)

Category	Specification
Signal type	1 Hz signal
Pulse	Positive pulse, reference edge is rising edge
Maximum voltage	5 V
Threshold	0.4 V to 0.6 V
Input impedance	45 ohms to 55 ohms
Pulse width	1μs to 500ms

The pinouts of the PTP-SYNC unit GPS/SYNC IN port are specified in Table 54.

Table 54 GPS/SYNC IN port pinouts

Pin no.	Connector pinout signal name	Signal description
Pin 1	12VGPS	12 V output to GPS receiver module, 250 mA max
Pin 2	GND	Ground
Pin 3	GPS_1PPSA	1 Hz pulse input
Pin 4	GPS_RXDA	GPS receive data
Pin 5	GPS_RXDB	GPS receive data
Pin 6	GPS_1PPSB	1 Hz pulse input
Pin 7	GPS_TXDA	GPS transmit data
Pin 8	GPS_TXDB	GPS transmit data

NOTE
The GPS_1PPS, GPS_RXD and GPS_TXD signals conform to International Telecommunication Union (ITU) recommendation V.11 (RS422).

Signal polarities

A 1 PPS timing datum is detected when GPS_1PPSA goes positive relative to GPS_1PPSB. A serial data start bit is detected when GPS_RXDA (or GPS_TXDA) goes positive relative to GPS_RXDB (or GPS_TXDB).

Fiber specifications

The characteristics of the laser device are:

- Type Class 1, Vertical Cavity Surface Emitting Laser
- Operating Wavelength 850nm or 1310nm
- EN60825-1 (1994) + A1:2002 +A2:2001

There are two versions of the fiber interface upgrade kit; one contains a 1000BaseSX (850 nm) SFP module (Table 55) and the other contains a 1000BaseLX (1310 nm) SFP module (Table 56). The components of these kits are not interchangeable. The fiber optic cable and fiber optic cable terminations are not supplied as part of the kits.

Table 55 Fiber Ethernet interface specifications (1000BaseSX)

Core / cladding (microns)	Mode	Bandwidth at 850 nm (MHz / km)	Maximum length of fiber interface	Insertion loss (dB)
62.5/125	Multi	160	220 m (720 ft)	2.38
62.5/125	Multi	200	275 m (900 ft)	2.6
50/125	Multi	400	500 m (1640 ft)	3.37
50/125	Multi	500	550 m (1800 ft)	3.56

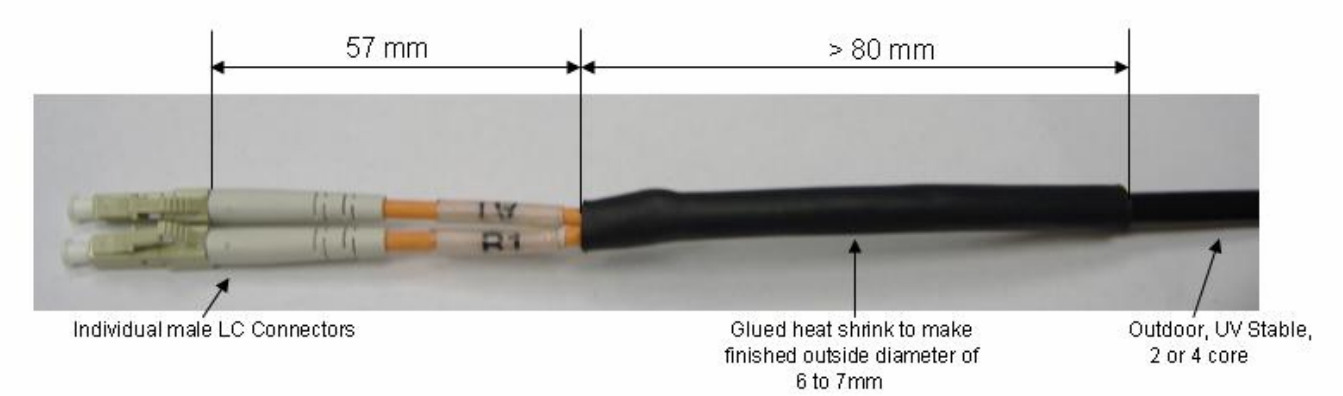
Table 56 Fiber Ethernet interface specifications (1000BaseLX)

Core / cladding (microns)	Mode	Bandwidth at 1310 nm (MHz / km)	Maximum length of fiber interface	Insertion loss (dB)
62.5/125	Multi	500	550 m (1800 ft)	1.67
50/125	Multi	400	550 m (1800 ft)	0.07
50/125	Multi	500	550 m (1800 ft)	1.19
10/125	Single	N/A	5000 m (16400 ft)	0.16

Fiber optic cable and connectors

The fiber optic cable and connectors are not supplied as part of the fiber upgrade kit. Order them from a specialist fiber optic cable fabricator, quoting the specification shown in Figure 42.

Figure 42 Fiber optic cable and connector specification


57 mm
> 80 mm
Individual male LC Connectors
Glued heat shrink to make finished outside diameter of 6 to 7mm
Outdoor, UV Stable, 2 or 4 core

This specification is based on the following considerations:

- Individual LC connectors are specified to aid installation and removal of the fiber optic cable assembly to and from the SFP module installed in the ODU.
- The finished diameter of the cable where the weatherproofing gland clamps the cable should be between 6 mm and 7 mm. If the finished diameter is less than 6 mm, the weatherproofing gland may not seal correctly. If the finished diameter is greater than 7 mm it will be difficult to assemble the weatherproofing gland without damaging the fiber optic cable.
- Assembly can be made easier by fitting the weatherproofing gland before fitting the connectors to the fiber optic cable.
- LC connectors should be supplied with dust caps to prevent dust build up.

Wireless specifications

This section contains specifications of the PTP 600 wireless interface. These specifications include RF bands, channel bandwidth, spectrum settings, maximum power and link loss.

General wireless specifications

Table 57 lists the wireless specifications that apply to all PTP 600 variants. Table 58 lists the wireless specifications that are specific to each frequency variant.

Table 57 PTP 600 wireless specifications (all variants)

Item	Specification
Channel selection	Manual selection (fixed frequency). Dynamic frequency selection (DFS or DFS with i-DFS) is available in radar avoidance regions.
Manual power control	To avoid interference to other users of the band, maximum power can be set lower than the default power limit.
Integrated antenna type	Flat plate antenna
Duplex scheme	Symmetric fixed, asymmetric fixed or adaptive TDD
Range	Optical Line-of-Sight: 200 km (125 miles). Non-Line-of-Sight: 10 km (6 miles).
Over-the-air encryption	Proprietary scrambling mechanism.
Weather sensitivity	Sensitivity at higher modes may be reduced by adjusting the Adaptive Modulation Threshold.
Error Correction	FEC

Table 58 PTP 600 wireless specifications (per frequency variant)

Item	PTP 25600	PTP 45600	PTP 48600	PTP 49600	PTP 54600	PTP 58600	PTP 59600
RF band (GHz)	2.496-2.568 2.572-2.614 2.618-2.690	4.400 - 4.600	4.710 - 5.000	4.900 - 4.990	5.470 - 5.725	5.725 - 5.850	5.825 - 5.925
Channel bandwidth	5 MHz 10 MHz 15 MHz 30 MHz	5 MHz 10 MHz 15 MHz 20 MHz 30 MHz	5 MHz 10 MHz 15 MHz 20 MHz	5 MHz 10 MHz 20 MHz	5 MHz 10 MHz 15 MHz 30 MHz (*2)	5 MHz 10 MHz 15 MHz 30 MHz (*2)	5 MHz 10 MHz 15 MHz 30 MHz
Typical receiver noise	5 dB	5 dB	5 dB	5 dB	6 dB	6 dB	6 dB
Typical antenna gain (integrated)	18 dBi	21.5 dBi	22 dBi	22 dBi (*1)	23 dBi	23 dBi	23 dBi
Antenna beamwidth (integrated)	18°	11°	11°	11°	8°	8°	8°
Max path loss (5 MHz channel)	157 dB	157 dB	157 dB	157 dB	169 dB	166 dB	166 dB

(*1) PTP 49600: maximum permitted antenna gain is 26 dBi.

(*2) PTP 54600 and 58600: Lite versions do not support channel bandwidth 5 MHz.

Available spectrum settings

This section shows how the spectrum available to each PTP 600 frequency variant is divided into radio channels. This division is based on configured parameters such as region code, channel bandwidth, channel raster and lower center frequency. Refer to the appropriate frequency variant as follows:

- PTP 25600 available spectrum settings on page 4-11
- PTP 45600 available spectrum settings on page 4-13
- PTP 48600 available spectrum settings on page 4-19
- PTP 49600 available spectrum settings on page 4-22
- PTP 54600 available spectrum settings on page 4-23
- PTP 58600 available spectrum settings on page 4-25
- PTP 59600 available spectrum settings on page 4-29

PTP 25600 available spectrum settings

The supported 2.5GHz frequency range is split into three bands, according to the bands specified in the FCC BRS-EBS Post-Transition Band plan (only for PTP 25600 and region code 16):

- Lower: 2496 MHz to 2572 MHz with a 5.5MHz channel raster (76 MHz total).
- Middle: 2572 MHz to 2614 MHz with a 6 MHz channel raster (42 MHz total).
- Upper: 2618 MHz to 2690 MHz with a 5.5 MHz channel raster (76 MHz total).

> **NOTE**
> For the PTP 25600 product variant, the unit will only operate in Fixed Frequency mode, and the user is unable to select i-DFS.

The PTP 25600 product variant support channel center frequencies as specified in Table 59. The 30MHz Channel Bandwidth is not supported in the FCC region.

Table 59 PTP 25600 channel plan - FCC BRS-EBS Post-Transition Band

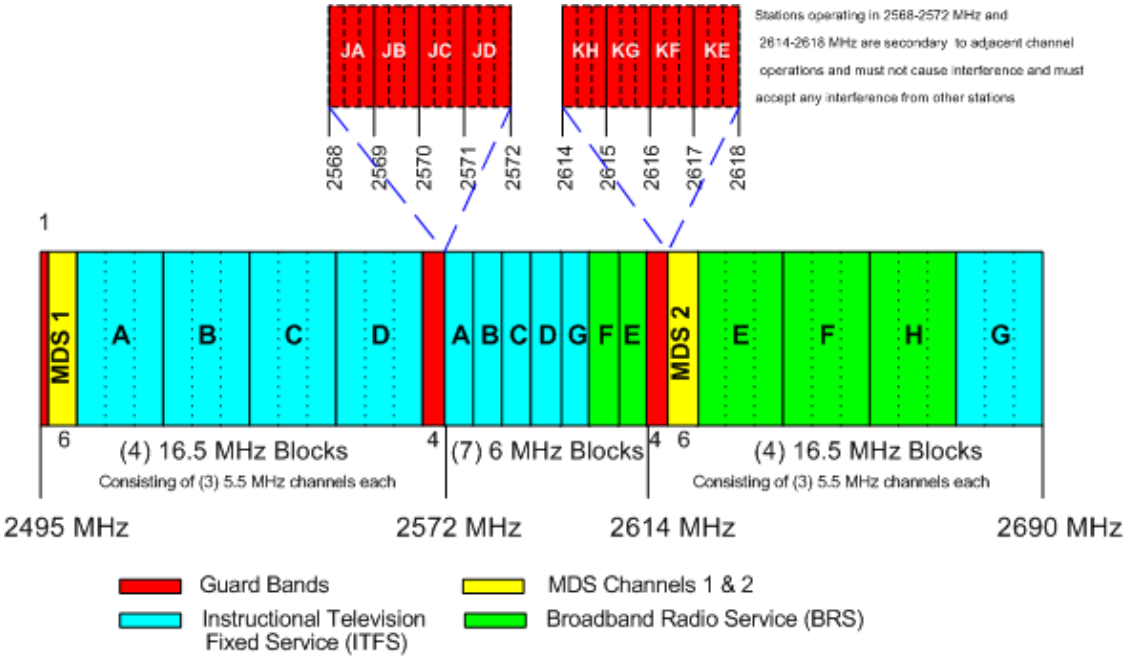
Block	Channel bandwidth (MHz)	Channel center frequencies (MHz)
Lower Band Segment	5	2499.25, 2504.75, 2510.25, 2515.75, 2521.25, 2526.75, 2532.25, 2537.75, 2543.25, 2548.75, 2554.25, 2559.75, 2565.25
	10	2502, 2507.5, 2513, 2518.5, 2524, 2529.5, 2535, 2540.5, 2546, 2551.5, 2557, 2562.5
	15	2504.75, 2510.25, 2515.75, 2521.25, 2526.75, 2532.25, 2537.75, 2543.25, 2548.75, 2554.25, 2559.75
	30	2513, 2524, 2535, 2546
Middle Band Segment	5	2575, 2581, 2587, 2593, 2599, 2605, 2611
	10	2578, 2584, 2590, 2596, 2602, 2608
	15	2581, 2587, 2593, 2599, 2605
	30	2587, 2599
Upper Band Segment	5	2626.75, 2632.25, 2637.75, 2643.25, 2648.75, 2654.25, 2659.75, 2665.25, 2670.75, 2676.25, 2681.75, 2687.25
	10	2629.5, 2635, 2640.5, 2646, 2651.5, 2657, 2662.5, 2668, 2673.5, 2679, 2684.5
	15	2632.25, 2637.75, 2643.25, 2648.75, 2654.25, 2659.75, 2665.25, 2670.75, 2676.25, 2681.75
	30	2640.5, 2651.5, 2662.5, 2673.5

The channel center frequencies listed above have been selected to align with the so-called post-transition BRS channels as shown in Figure 43.

The PTP 25600 frequency variant supports three portions of the BRS spectrum allocation. These are configurable at installation and constrain the wireless to operate in a limited portion of the Spectrum. The three frequency bands are as shown in Figure 43:

- **Band 1**: channels A, B, C and D (16.5 MHz blocks)
- **Band 2**: channels A through G (6 MHz blocks)
- **Band 3**: channels E, F, G and H (16.5 MHz blocks)

Figure 43 PTP 25600 BRS band channel assignments


JA JB JC JD
KH KG KF KE
Stations operating in 2568-2572 MHz and 2614-2618 MHz are secondary to adjacent channel operations and must not cause interference and must accept any interference from other stations
2568 2569 2570 2571 2572
2614 2615 2616 2617 2618
1
MDS 1
A B C D
A B C D G F E
MDS 2
E F H G
6
(4) 16.5 MHz Blocks
Consisting of (3) 5.5 MHz channels each
4
(7) 6 MHz Blocks
4 6
(4) 16.5 MHz Blocks
Consisting of (3) 5.5 MHz channels each
2495 MHz
2572 MHz
2614 MHz
2690 MHz
Guard Bands
MDS Channels 1 & 2
Instructional Television Fixed Service (ITFS)
Broadband Radio Service (BRS)

PTP 45600 available spectrum settings

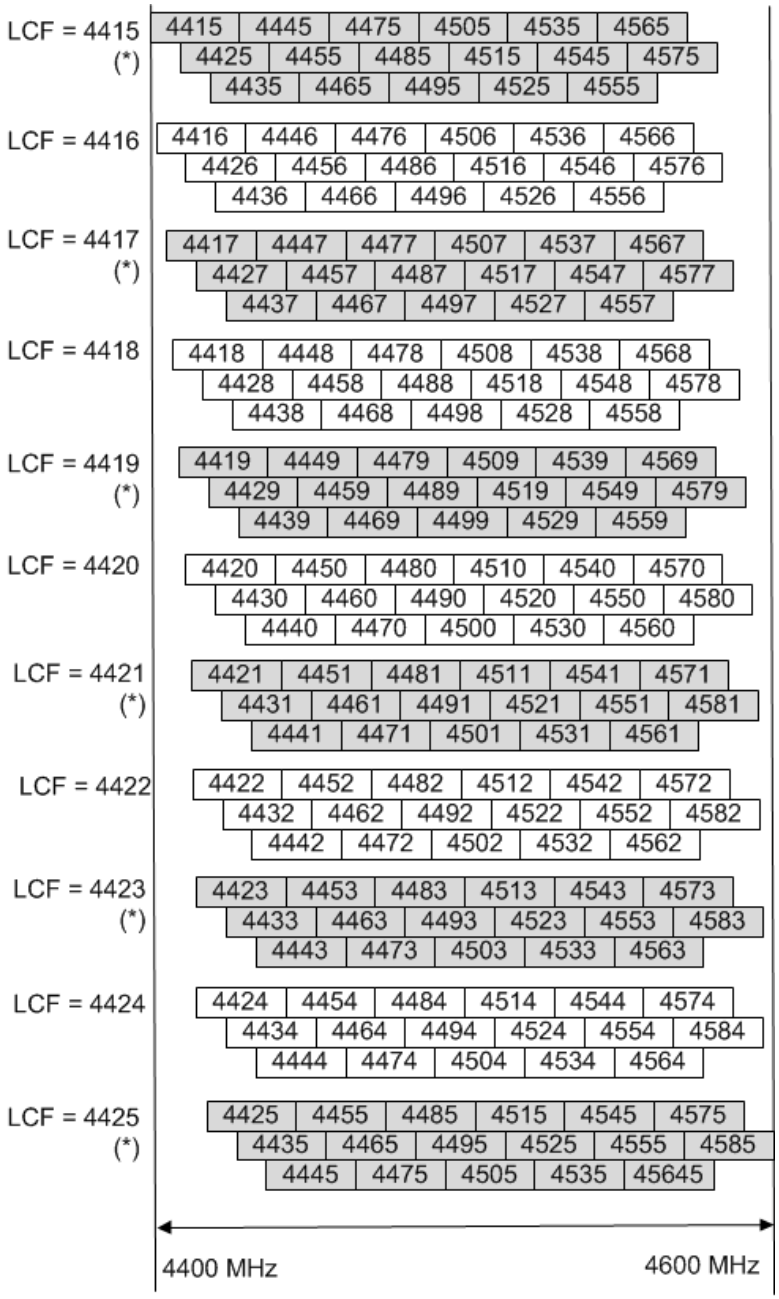
The PTP 45600 product variant does not apply any band edge power reduction.

> **NOTE**
> To identify the RF card version that is fitted in a PTP 45600 ODU, refer to the System Status page (as described in Viewing the system status on page 7-6). The Hardware Version attribute is formatted as *Dxx-Ryy-z*, where *Ryy* contains the version of the RF card. For example, *R02* means that the ODU is fitted with RF card version 2.

Region code 23:

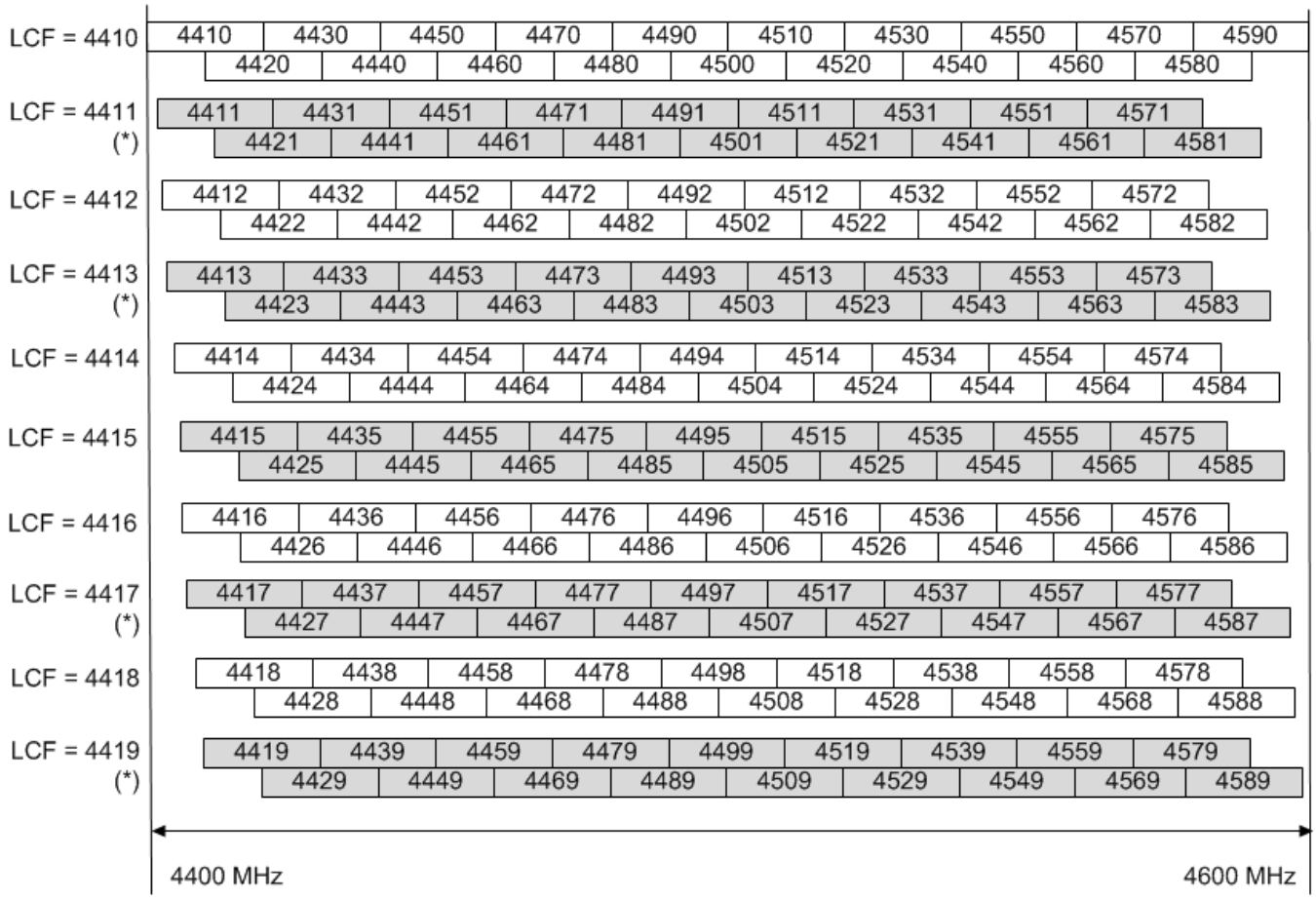
- Use the Lower Center Frequency attribute (see Step 2: Wireless configuration on page 6-51) to slide the available channels up and down the 4.5 GHz band in steps of 1 MHz (ODUs fitted with RF card version 2 or greater) or 2 MHz (ODUs fitted with RF card version 0 or 1).
- In the 30 MHz (Figure 44) and 20 MHz (Figure 45) channel bandwidths, the PTP 45600 operates on a 10 MHz channel raster.
- In the 15 MHz (Figure 46), 10 MHz (Figure 47) and 5 MHz (Figure 48) channel bandwidths, the PTP 45600 variant operates on a 6 MHz channel raster.
- The channel raster is set to even center frequencies.

Figure 44 PTP 45600 available spectrum in 30 MHz channel bandwidth (RC 23)



(*) These LCFs are only available with RF card version 2 or greater

Figure 45 PTP 45600 available spectrum in 20 MHz channel bandwidth (RC 23)

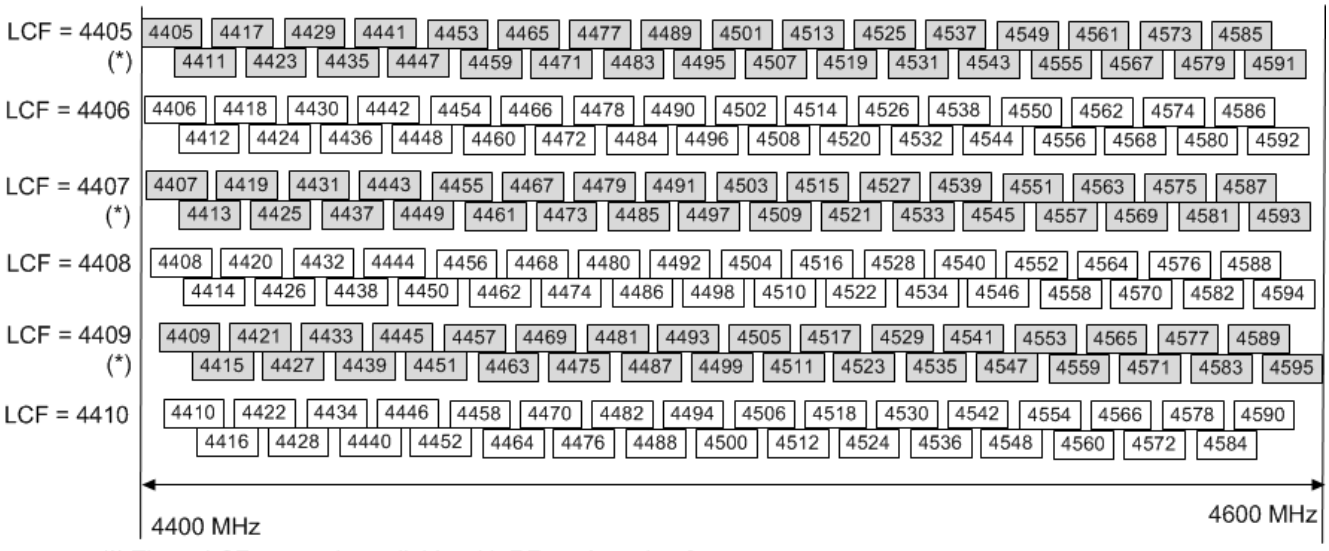


(*) These LCFs are only available with RF card version 2 or greater

Figure 46 PTP 45600 available spectrum in 15 MHz channel bandwidth (RC 23)

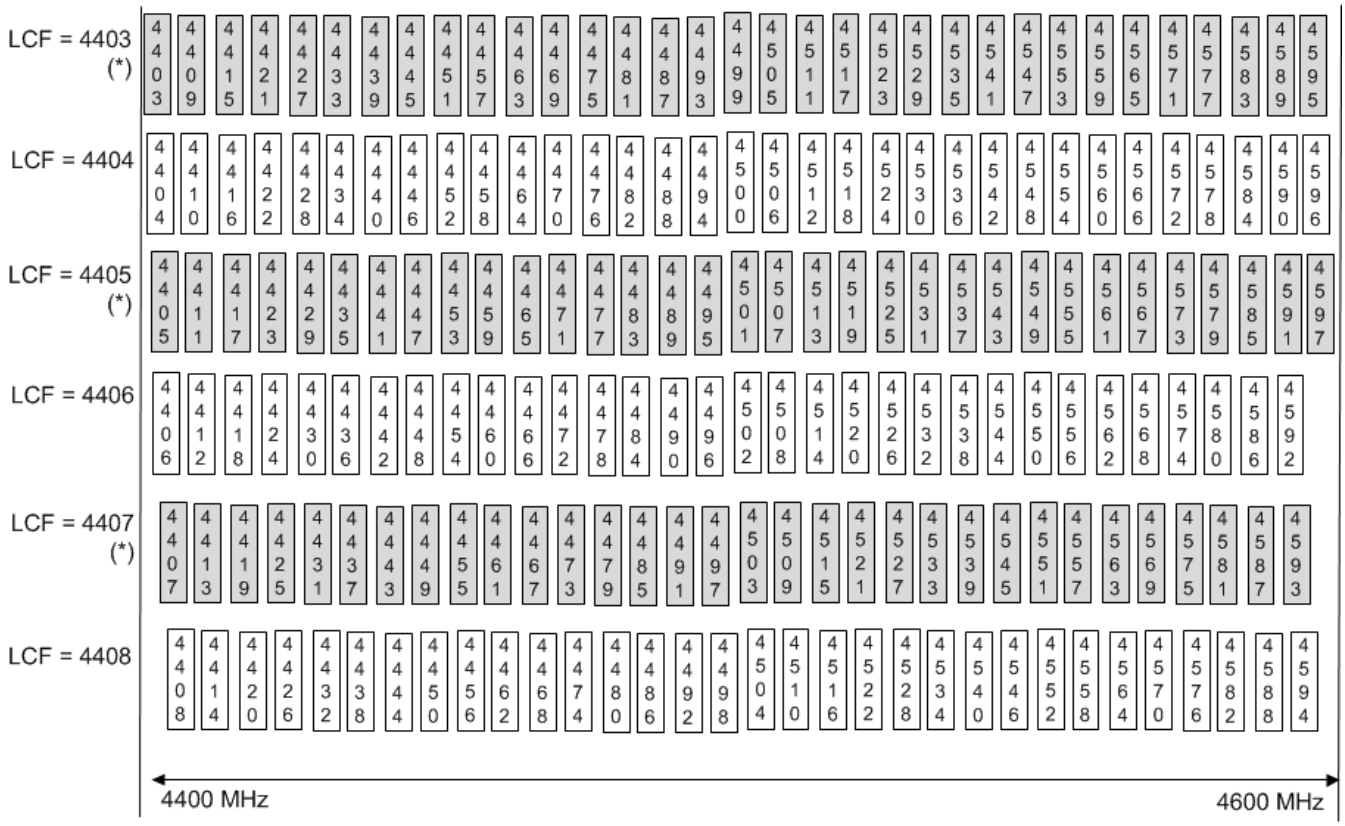
(*) These LCFs are only available with RF card version 2 or greater

Figure 47 PTP 45600 available spectrum in 10 MHz channel bandwidth (RC 23)



(*) These LCFs are only available with RF card version 2 or greater

Figure 48 PTP 45600 available spectrum in 5 MHz channel bandwidth (RC 23)



(*) These LCFs are only available with RF card version 2 or greater

Region code 24 (NTIA):

- In the 30 MHz (Figure 49) channel bandwidth, the PTP 45600 variant operates on a 30 MHz channel raster. This bandwidth is only available in ODUs fitted with RF card version 2 or greater.
- In the 20 MHz (Figure 50) channel bandwidth, the PTP 45600 variant operates on a 20 MHz channel raster.
- In the 10 MHz (Figure 51) channel bandwidth, the PTP 45600 variant operates on a 10 MHz channel raster.

Figure 49 PTP 45600 available spectrum in 30 MHz channel bandwidth (RC 24)

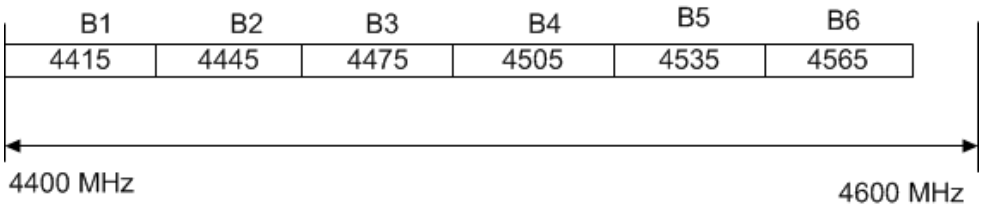


Figure 50 PTP 45600 available spectrum in 20 MHz channel bandwidth (RC 24)

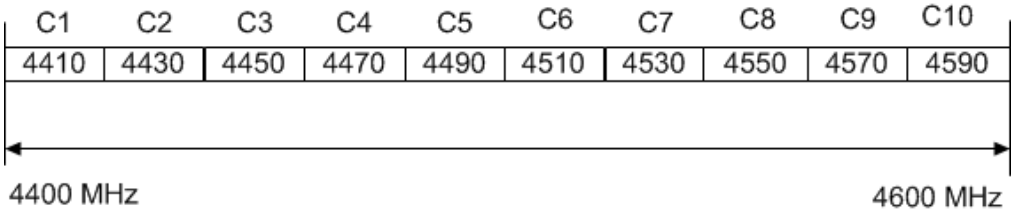
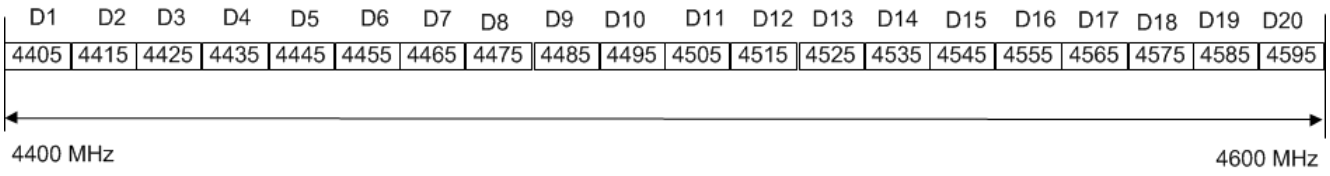


Figure 51 PTP 45600 available spectrum in 10 MHz channel bandwidth (RC 24)



PTP 48600 available spectrum settings

Region codes 15 and 23: Use the Lower Center Frequency attribute (see Step 2: Wireless configuration on page 6-51) to slide the available channels up and down the 4.8 GHz band in steps of 1 MHz. In the 20 MHz (Figure 52) channel bandwidth, the PTP 48600 variant operates on a 10 MHz channel raster. In the 15 MHz (Figure 53), 10 MHz (Figure 54) and 5 MHz (Figure 55) channel bandwidths, the PTP 48600 variant operates on a 5 MHz channel raster. The default channel raster is set to even frequencies as that optimizes radio performance.

Figure 52 PTP 48600 available spectrum in 20 MHz channel bandwidth

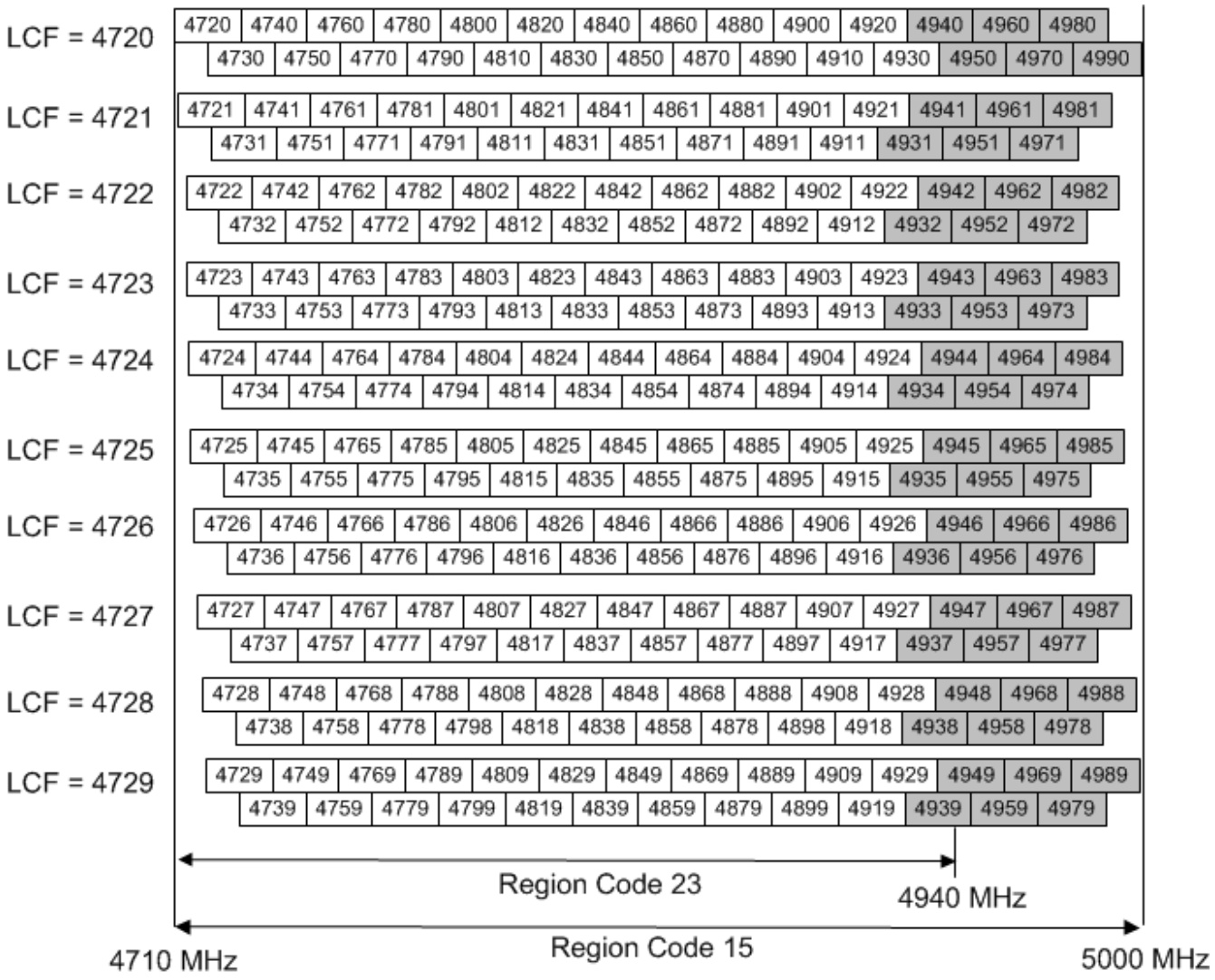


Figure 53 PTP 48600 available spectrum in 15 MHz channel bandwidth

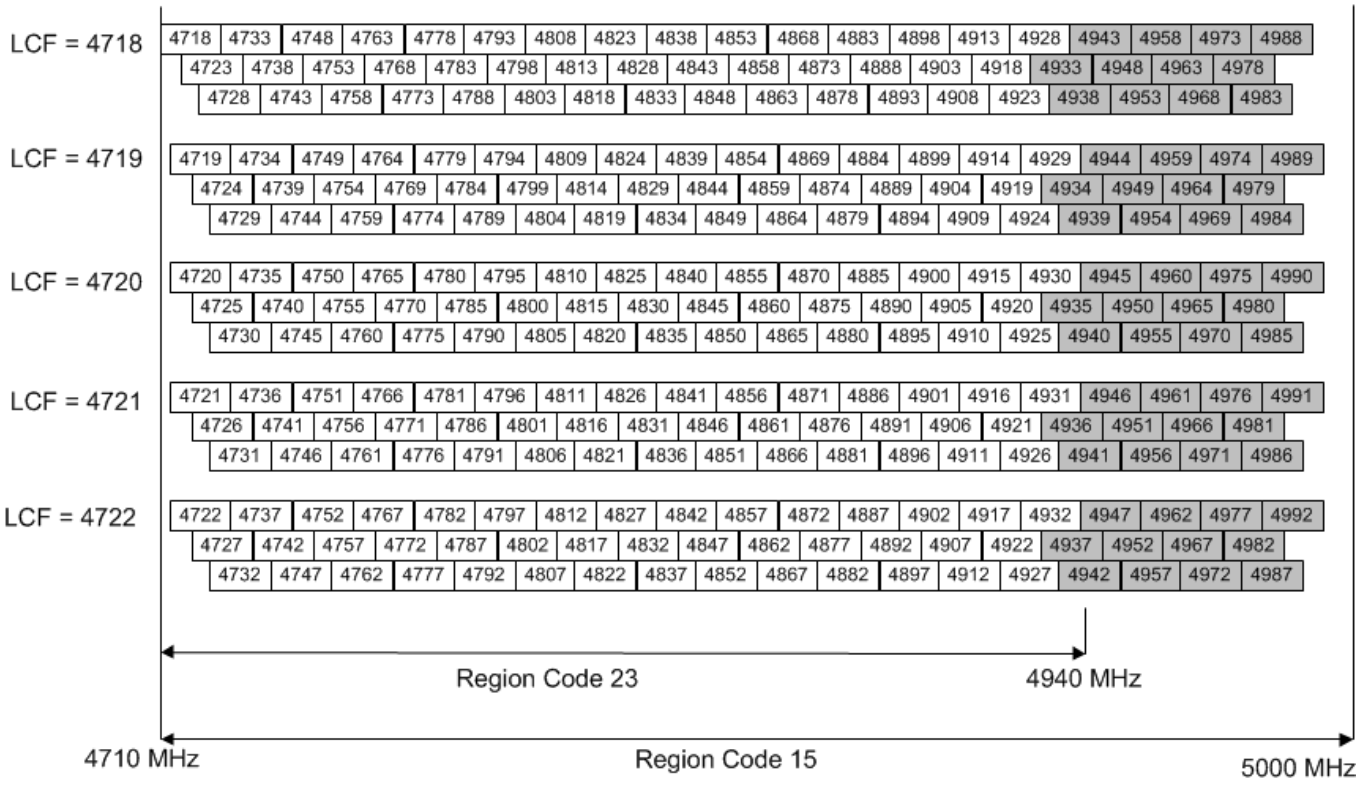


Figure 54 PTP 48600 available spectrum in the 10 MHz channel bandwidth

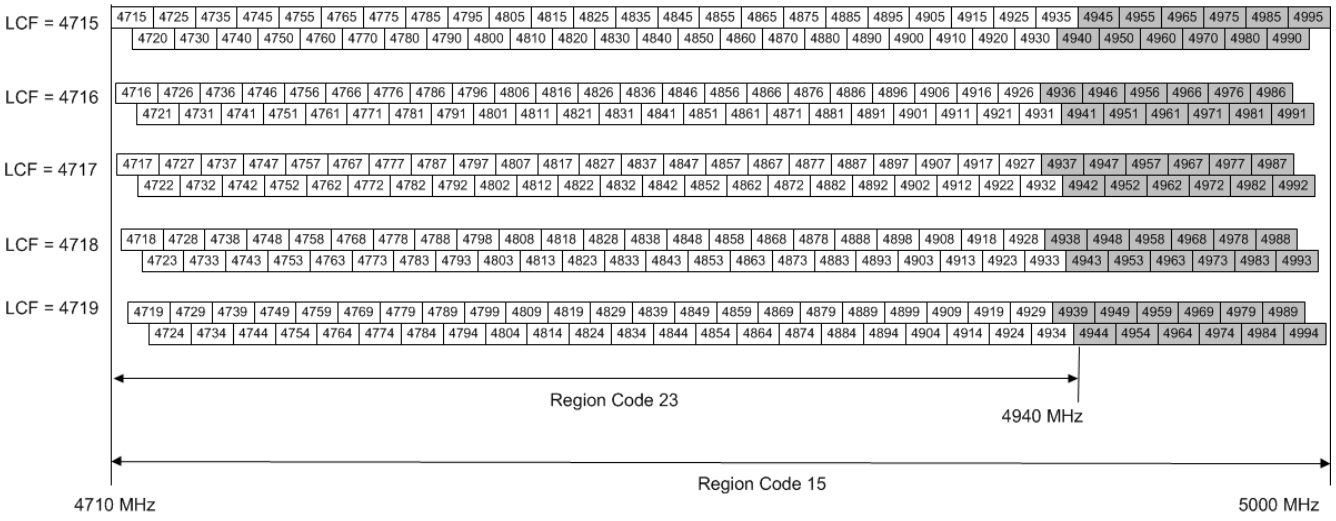
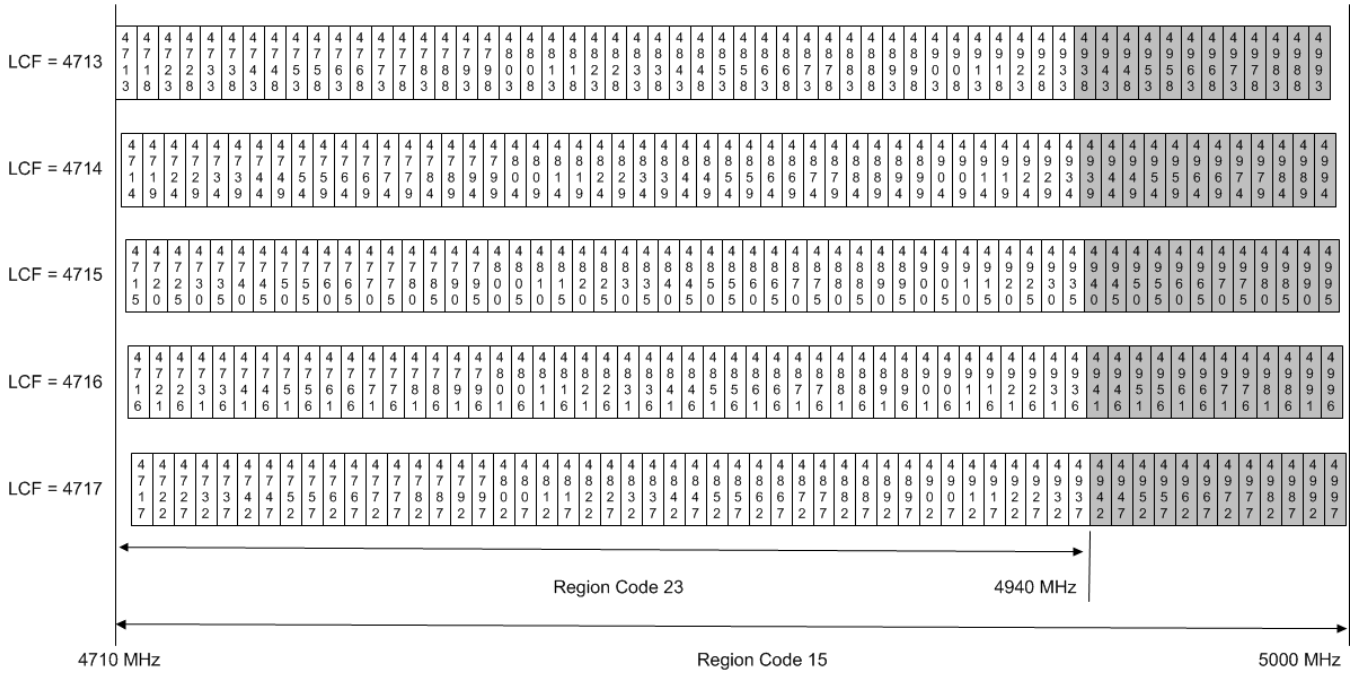


Figure 55 PTP 48600 available spectrum in 5 MHz channel bandwidth



Region code 24 (NTIA): In the 20 MHz (Figure 56) channel bandwidth, the PTP 48600 variant operates on a 20 MHz channel raster. In the 10 MHz (Figure 57) channel bandwidth, the PTP 48600 variant operates on a 10 MHz channel raster. The channel raster is set to even center frequencies.

Figure 56 PTP 48600 available spectrum in the 20 MHz channel bandwidth (RC 24)

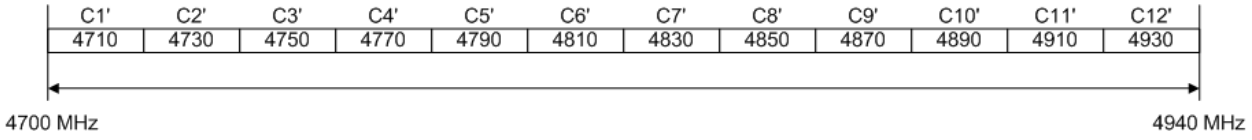
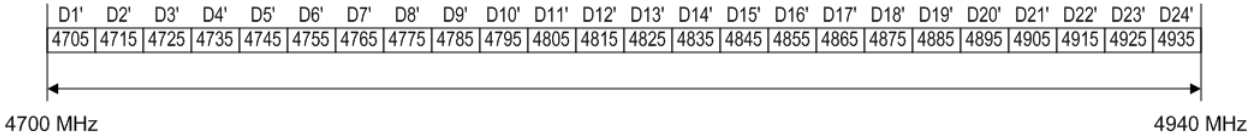


Figure 57 PTP 48600 available spectrum in 10 MHz channel bandwidth (RC 24)



PTP 49600 available spectrum settings

In the 20 MHz (Figure 58), 10 MHz (Figure 59) and 5 MHz (Figure 60) channel bandwidths, the PTP 49600 variant operates on a 5 MHz channel raster.

> **NOTE**
> These tables contain data for one typical region code. The specified channel center frequencies may not be available in other region codes.

The PTP 49600 product variant does not apply any band edge power reduction.

Figure 58 PTP 49600 available spectrum in 20 MHz channel bandwidth

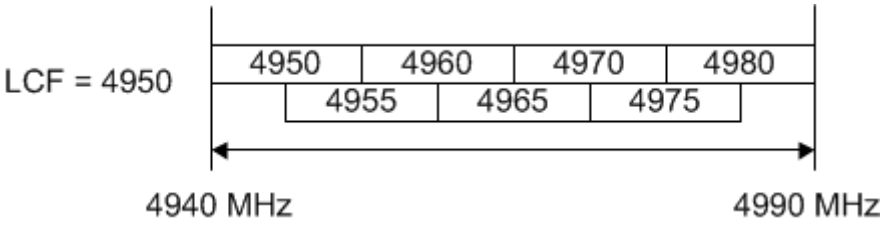


Figure 59 PTP 49600 available spectrum in the 10 MHz channel bandwidth

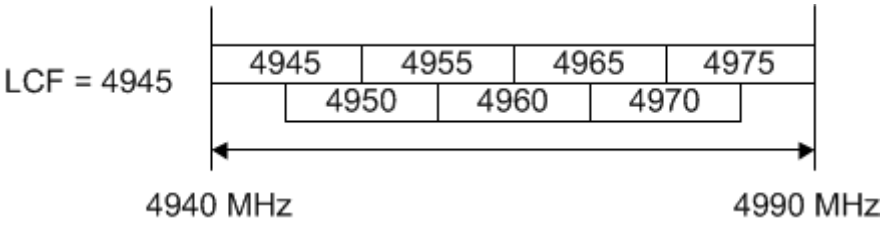
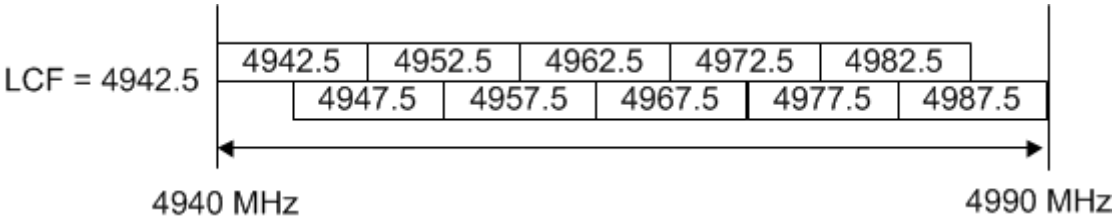


Figure 60 PTP 49600 available spectrum in the 5 MHz channel bandwidth



PTP 54600 available spectrum settings

Use the Lower Center Frequency attribute (see Step 2: Wireless configuration on page 6-51) to slide the available channels up and down the 5.4 GHz band in steps of 2 MHz.

In the 30 MHz channel bandwidth (Figure 61), the PTP 54600 variant operates on a 10 MHz channel raster. In the 15 MHz (Figure 62), 10 MHz (Figure 63) and 5 MHz (Figure 64) channel bandwidths, the PTP 54600 variant operates on a 6 MHz channel raster. The channel raster is set to even center frequencies. The PTP 54600 product variant does not apply any band edge power reduction.

NOTE

These tables contain data for one typical region code. The specified channel center frequencies may not be available in other region codes.

Figure 61 PTP 54600 available spectrum in 30 MHz channel bandwidth

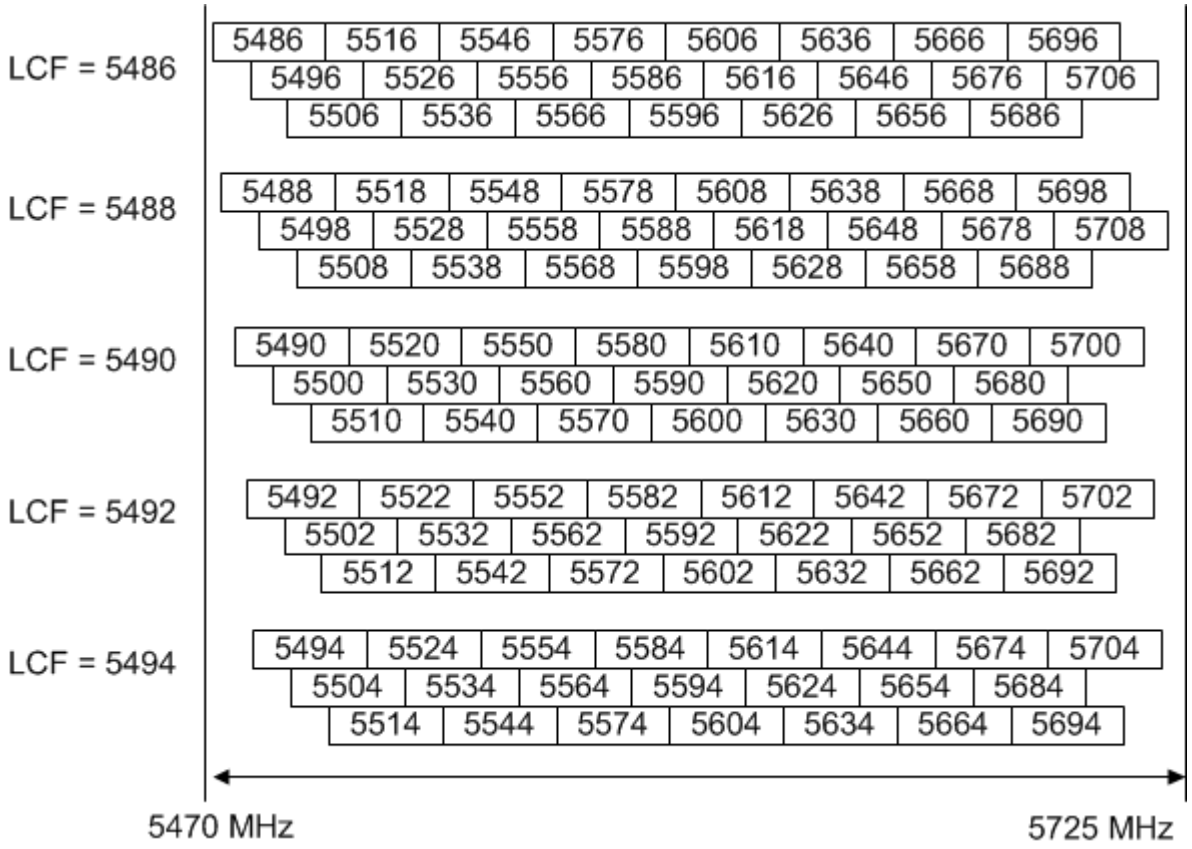


Figure 62 PTP 54600 available spectrum in 15 MHz channel bandwidth

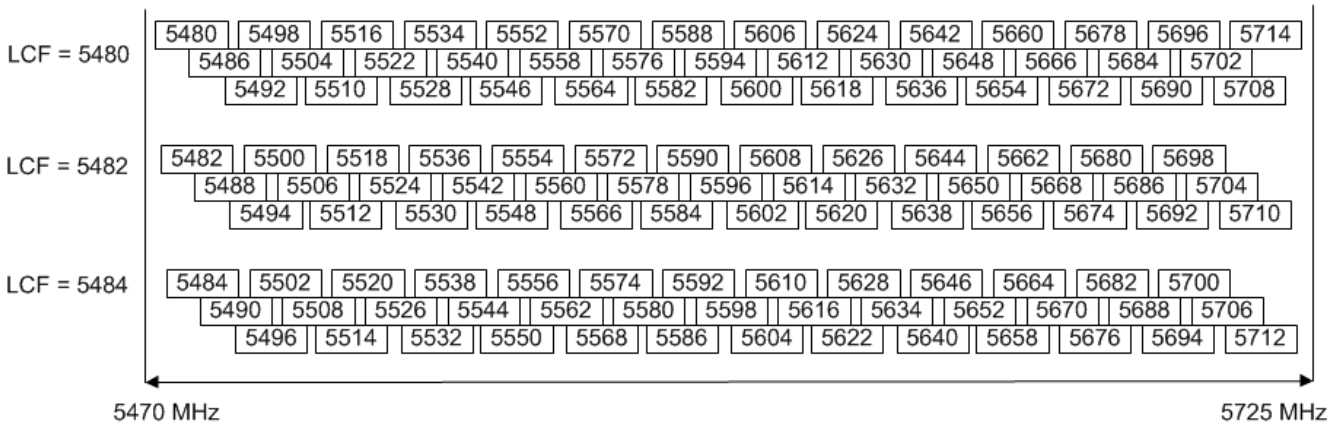


Figure 63 PTP 54600 available spectrum in 10 MHz channel bandwidth

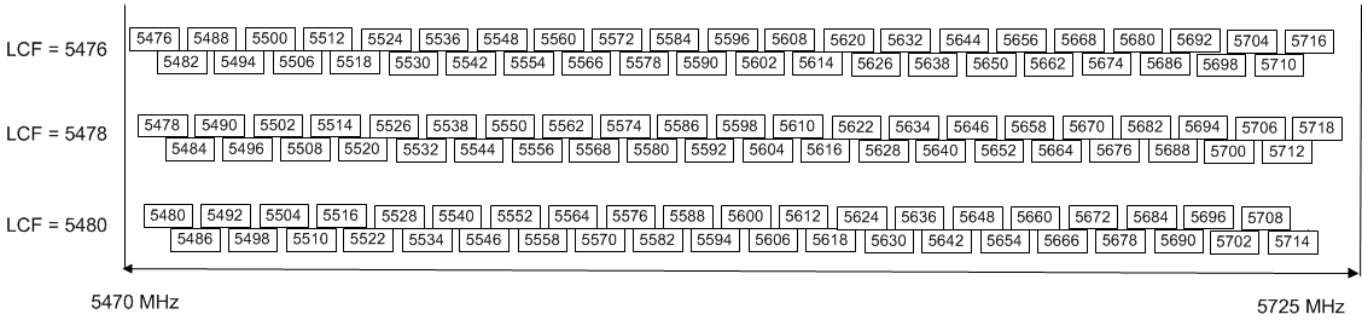
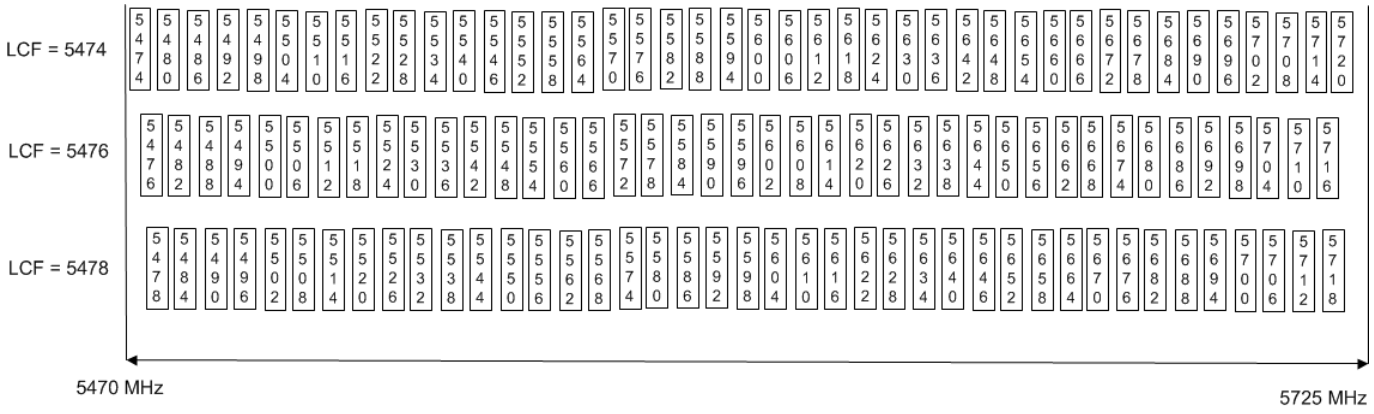


Figure 64 PTP 54600 available spectrum in 5 MHz channel bandwidth



PTP 58600 available spectrum settings

Use the Lower Center Frequency attribute (see Step 2: Wireless configuration on page 6-51) to slide the available channels up and down the 5.8 GHz band in steps of 2 MHz.

In the 30 MHz channel bandwidth (Figure 65), the PTP 58600 variant operates on a 10 MHz channel raster. In the 15 MHz (Figure 66), 10 MHz (Figure 67) and 5 MHz (Figure 68) channel bandwidths, the PTP 58600 variant operates on a 6 MHz channel raster. The channel raster is set to even center frequencies.

> **NOTE**
> These tables contain data for one typical region code. The specified channel center frequencies may not be available in other region codes.

Figure 65 PTP 58600 available spectrum in 30 MHz channel bandwidth

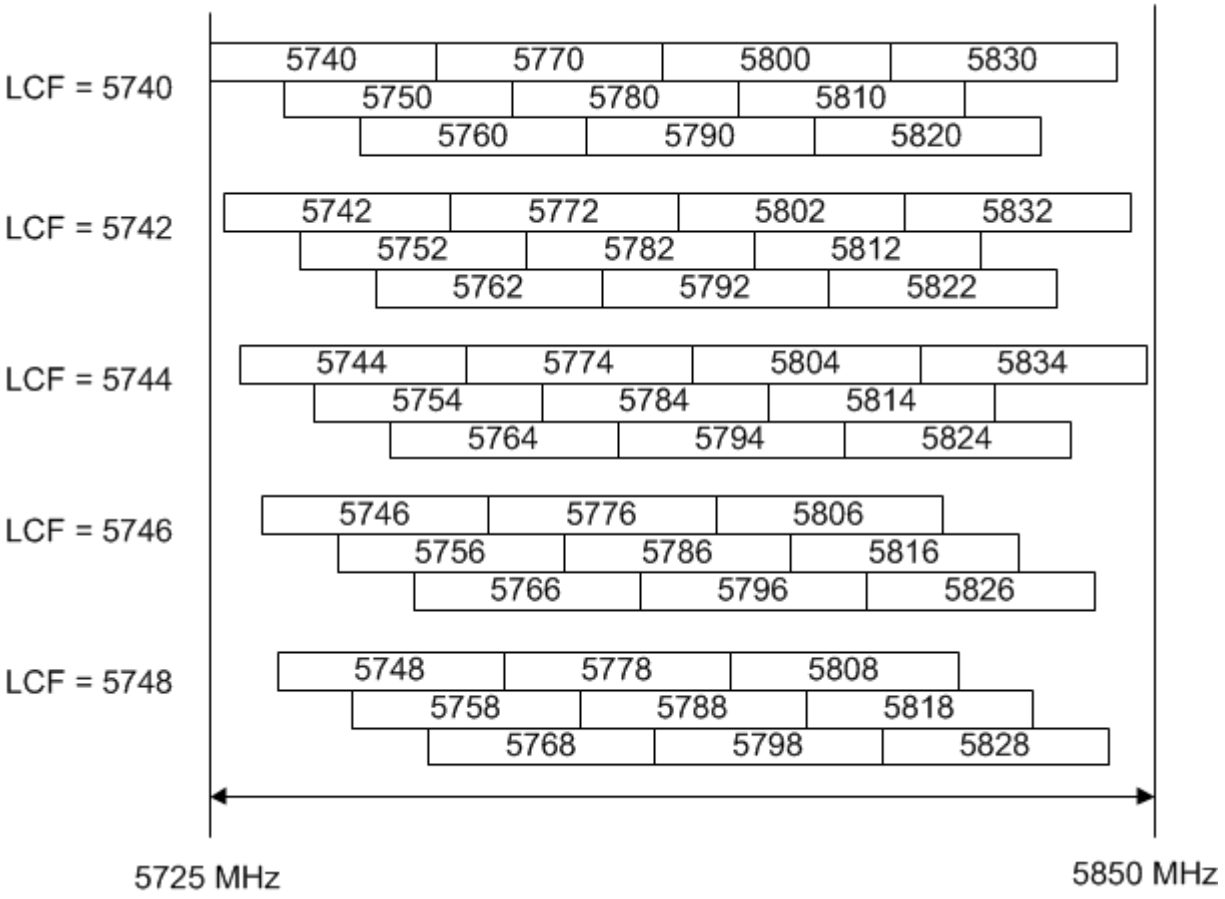


Figure 66 PTP 58600 available spectrum in 15 MHz channel bandwidth

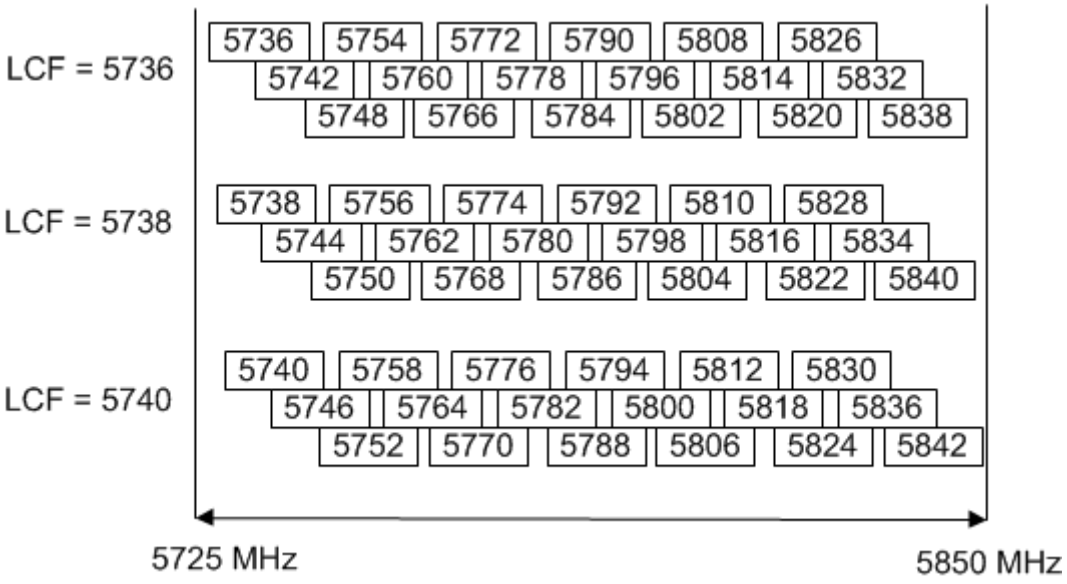


Figure 67 PTP 58600 available spectrum in the 10 MHz channel bandwidth

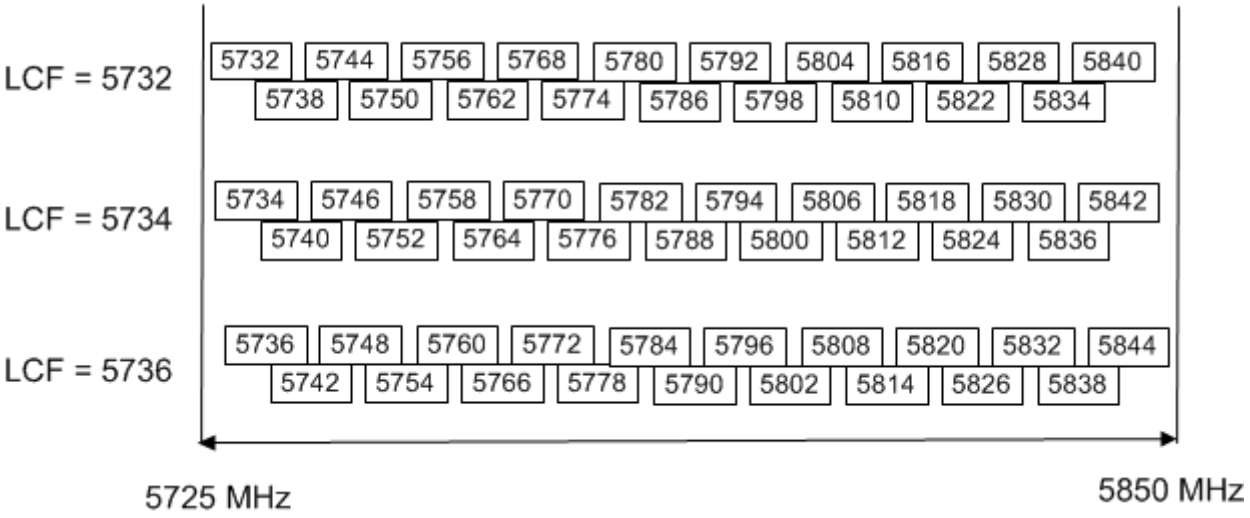
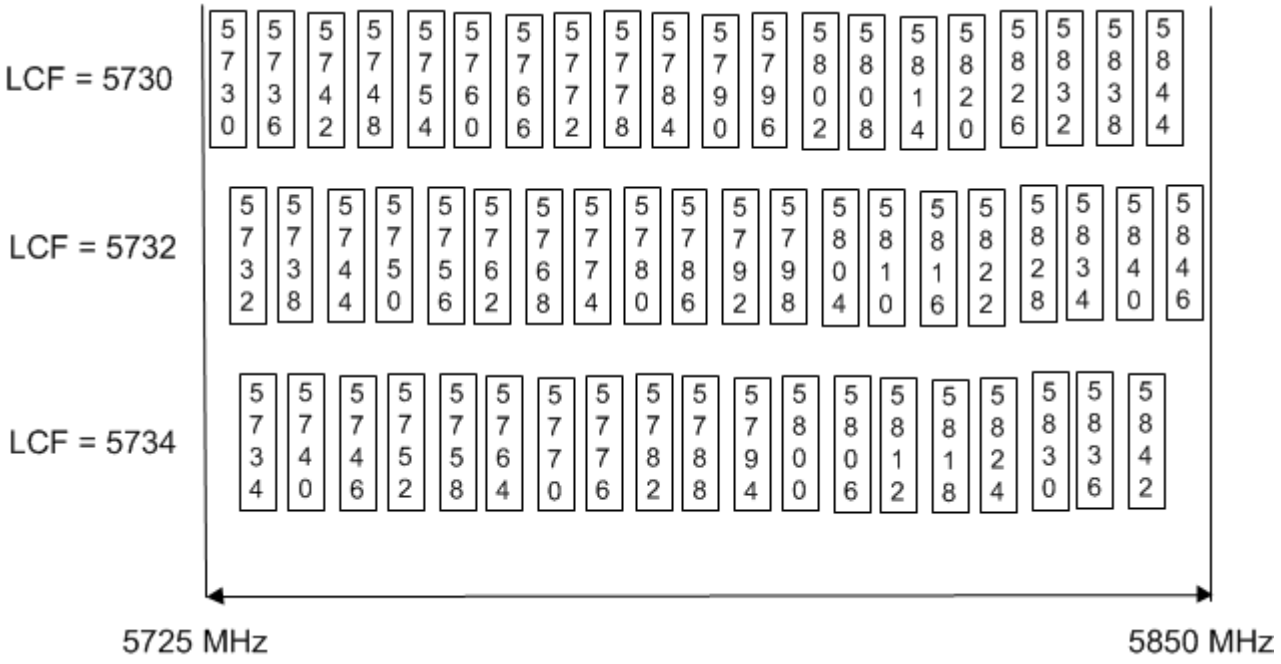


Figure 68 PTP 58600 available spectrum in 5 MHz channel bandwidth



PTP 58600 transmit power reduction at the band edges

Operation at or near the 5.8 GHz band edges can results in a lower maximum transmit power. In some configurations the PTP 600 Series solution reduces the power when operating at the edge channels. The amount of reduction, if any, is dependent on the region code of the region of operation. This currently only affects systems configured with region code 1. The power reductions in the edge channels for 5 MHz, 10 MHz, 15 MHz and 30 MHz are presented in Table 60 (for region code 1 ONLY).

Table 60 PTP 58600 band edge Tx power reduction

Power Levels for Channel Center	Channel Width (MHz)			
	5	10	15	30
5730	25	N/A	N/A	N/A
5732	25	23	N/A	N/A
5734	25	25	N/A	N/A
5736	25	25	23	N/A
5738	25	25	25	N/A
5740	25	25	25	17
5742 - 5750	25	25	25	21
5752 - 5822	25	25	25	25
5824 - 5832	25	25	25	21
5834	25	25	25	17
5840	25	25	23	N/A
5842	25	23	19	N/A
5844	25	19	N/A	N/A
5846	23	N/A	N/A	N/A

PTP 59600 available spectrum settings

Use the Lower Center Frequency attribute (see Step 2: Wireless configuration on page 6-51) to slide the available channels up and down the 5.9 GHz band in steps of 2 MHz.

In the 30 MHz channel bandwidth (Figure 69) the PTP 59600 variant operates on a 10 MHz channel raster. In the 15 MHz (Figure 70), 10 MHz (Figure 71) and 5 MHz (Figure 72) channel bandwidths, the PTP 59600 variant operates on a 6 MHz channel raster. The channel raster is set to even center frequencies.

> **NOTE**
> These tables contain data for one typical region code. The specified channel center frequencies may not be available in other region codes.

The PTP 59600 product variant does not apply any band edge power reduction.

Figure 69 PTP 59600 available spectrum in 30 MHz channel bandwidth

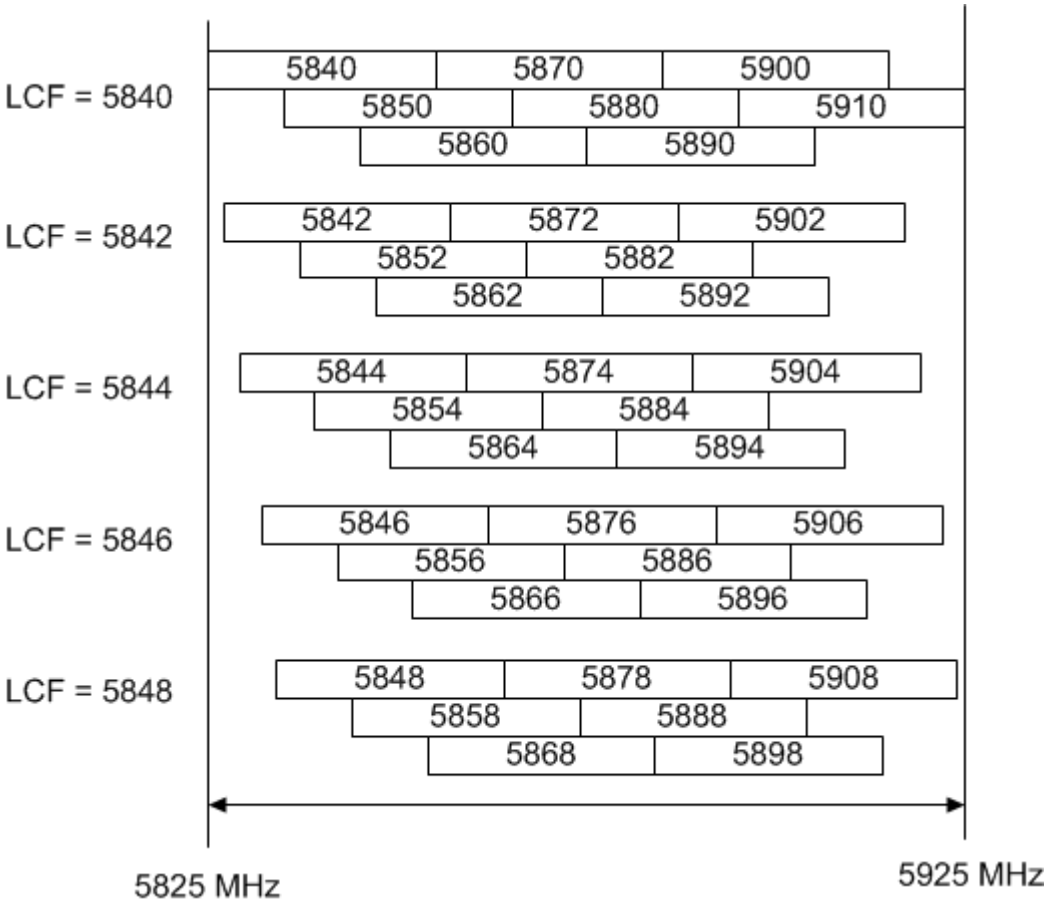


Figure 70 PTP 59600 available spectrum in 15 MHz channel bandwidth

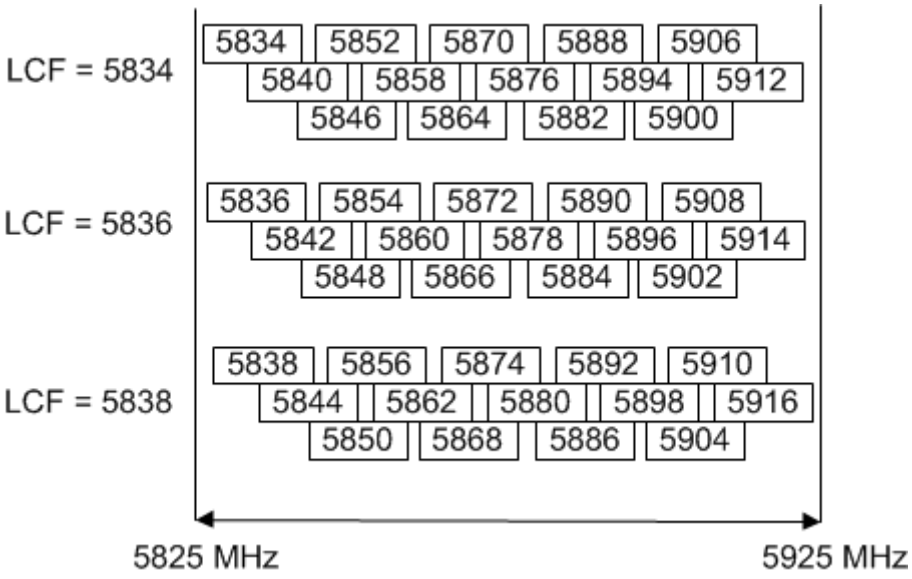


Figure 71 PTP 59600 available spectrum in 10 MHz channel bandwidth

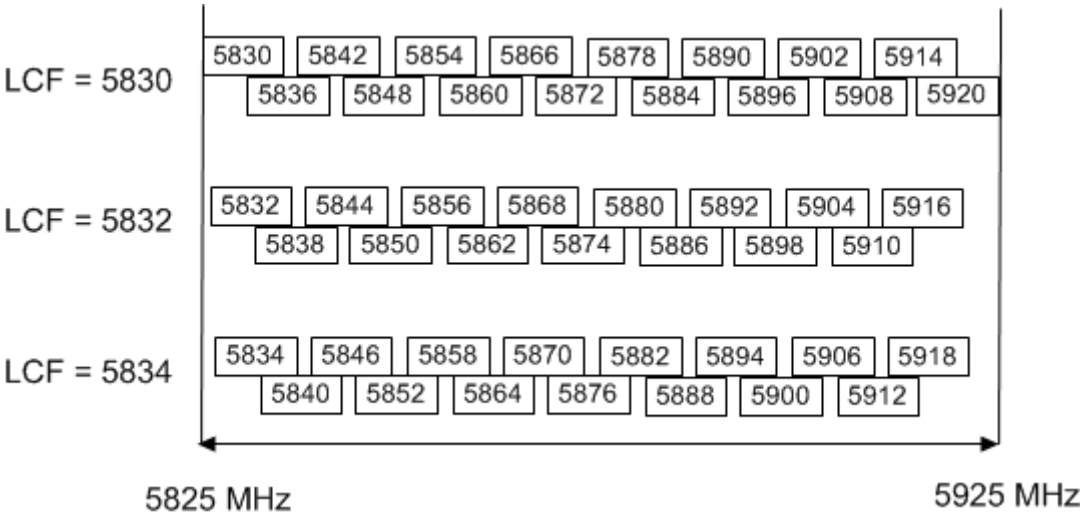
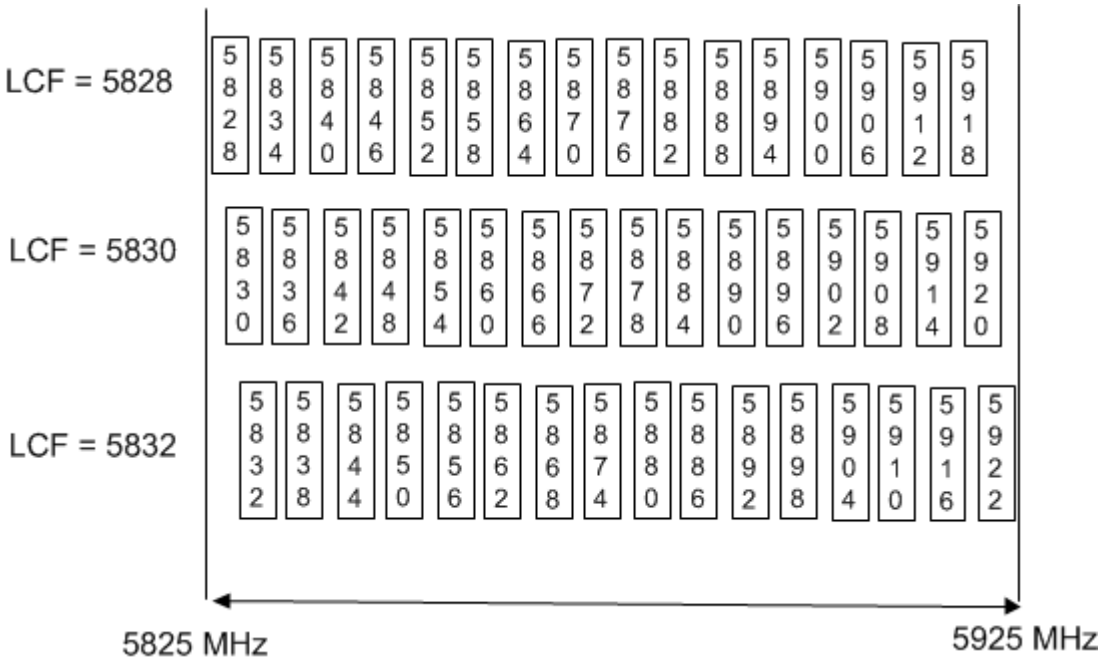


Figure 72 PTP 59600 available spectrum in 5 MHz channel bandwidth



System threshold, output power and link loss

The following tables specify the system threshold (dBm), output power (dBm) and maximum link loss (dB) per channel bandwidth and modulation mode:

- Table 61 - PTP 25600 - IP mode
- Table 62 - PTP 25600 - TDM mode
- Table 63 - PTP 45600 - IP mode
- Table 64 - PTP 45600 - TDM mode
- Table 65 - PTP 48600 - IP mode
- Table 66 - PTP 48600 - TDM mode
- Table 67 - PTP 49600 - IP mode
- Table 68 - PTP 49600 - TDM mode
- Table 69 - PTP 54600 - IP mode
- Table 70 - PTP 54600 - TDM mode
- Table 71 - PTP 58600 - IP mode
- Table 72 - PTP 58600 - TDM mode
- Table 73 - PTP 59600 - IP mode
- Table 74 - PTP 59600 - TDM mode

Table 61 PTP 25600 - IP mode - threshold, power and link loss

Modulation mode	System threshold (dBm) per channel bandwidth				Output power (dBm)	Maximum link loss (dB) per channel bandwidth			
	5 MHz	10 MHz	15 MHz	20 MHz	All bands	5 MHz	10 MHz	15 MHz	20 MHz
BPSK 0.63 single	-97.6	-95.1	-93.0	-90.4	+23	156.6	154.1	152.0	149.4
QPSK 0.63 single	-93.9	-90.7	-90.5	-86.7	+23	152.9	149.7	146.6	145.7
QPSK 0.87 single	-90.7	-87.6	-87.5	-83.9	+23	149.7	146.6	146.5	142.9
16QAM 0.63 single	-89.1	-86.0	-86.0	-82.1	+23	148.0	145.5	145.0	140.4
16QAM 0.63 dual	-86.7	-83.9	-84.0	-79.4	+23	145.7	142.9	143.0	138.4
16QAM 0.87 single	-84.2	-82.5	-80.5	-76.5	+23	143.2	141.4	139.5	135.5
16QAM 0.87 dual	-81.0	-77.7	-77.4	-72.9	+23	140.0	136.6	136.4	131.9
64QAM 0.75 single	-81.6	-79.2	-77.4	-73.5	+23	140.6	138.2	136.4	132.4
64QAM 0.75 dual	-77.8	-74.7	-74.3	-69.8	+23	136.8	133.7	133.3	128.8
64QAM 0.92 single	-78.8	-76.3	-74.4	-70.3	+23	137.8	135.2	133.4	129.3
64QAM 0.92 dual	-75.5	-71.3	-71.9	-66.5	+23	134.5	130.3	130.9	125.5
256QAM 0.81 single	-77.2	-74.9	-72.9	-68.8	+23	136.2	133.9	131.9	127.8
256QAM 0.81 dual	-73.5	-70.1	-69.7	-65.1	+23	132.5	129.1	128.7	124.1

Table 62 PTP 25600 - TDM mode - threshold, power and link loss

Modulation mode	System threshold (dBm) per channel bandwidth				Output power (dBm)	Maximum link loss (dB) per channel bandwidth			
	5 MHz	10 MHz	15 MHz	20 MHz	All bands	5 MHz	10 MHz	15 MHz	20 MHz
BPSK 0.63 single	-97.6	-95.1	-93.0	-90.4	+23	156.6	154.1	152.0	149.4
QPSK 0.63 single	-91.6	-89.1	-88.2	-85.2	+23	150.6	148.1	147.2	144.2
QPSK 0.87 single	-88.3	-85.6	-85.1	-81.5	+23	147.3	144.6	144.1	140.5
16QAM 0.63 single	-86.4	-83.9	-83.5	-79.4	+23	145.4	142.9	142.5	138.4
16QAM 0.63 dual	-84.2	-80.8	-80.7	-76.6	+23	143.2	139.8	139.7	135.6
16QAM 0.87 single	-81.7	-78.1	-77.3	-73.6	+23	140.7	137.1	136.3	132.6
16QAM 0.87 dual	-78.6	-74.4	-74.3	-70.0	+23	137.6	133.4	133.3	129.0
64QAM 0.75 single	-78.8	-75.2	-74.2	-70.6	+23	137.8	134.2	133.2	129.6
64QAM 0.75 dual	-75.4	-71.0	-70.9	-66.7	+23	134.4	130.0	129.9	125.7
64QAM 0.92 single	-76.0	-73.4	-72.2	-68.6	+23	135.0	132.4	131.2	127.6
64QAM 0.92 dual	-73.5	-69.3	-68.9	-64.8	+23	132.5	128.2	127.9	123.8
256QAM 0.81 single	-73.4	-71.6	-69.1	-65.4	+23	132.4	130.6	128.1	124.4
256QAM 0.81 dual	-70.4	-67.6	-65.9	-61.6	+23	129.4	126.6	124.9	120.6

Table 63 PTP 45600 - IP mode - threshold, power and link loss

Modulation mode	System threshold (dBm) per channel bandwidth					Output power (dBm)	Maximum link loss (dB) per channel bandwidth				
	5 MHz	10 MHz	15 MHz	20 MHz	30 MHz	All bands	5 MHz	10 MHz	15 MHz	20 MHz	30 MHz
BPSK 0.63 single	-96.6	-93.7	-92.0	-90.4	-88.0	+27	166.6	163.7	162.0	160.4	158.0
QPSK 0.63 single	-92.0	-91.4	-89.3	-88.5	-85.8	+27	160.5	159.9	159.3	158.5	155.8
QPSK 0.87 single	-90.0	-87.6	-85.7	-84.9	-82.2	+27	160.0	157.6	155.7	154.9	152.2
16QAM 0.63 single	-88.3	-85.5	-83.3	-82.5	-80.1	+27	158.3	155.5	153.3	152.5	150.1
16QAM 0.63 dual	-85.5	-81.9	-79.5	-78.9	-77.1	+27	155.5	151.9	149.5	148.9	147.1
16QAM 0.87 single	-84.6	-80.7	-78.6	-77.8	-75.5	+27	154.6	150.7	148.6	147.8	145.5
16QAM 0.87 dual	-81.3	-77.3	-75.0	-74.3	-72.3	+27	151.3	147.3	145.0	144.3	142.3
64QAM 0.75 single	-81.2	-77.6	-75.5	-74.7	-72.4	+25	149.2	145.6	143.5	142.7	140.4
64QAM 0.75 dual	-78.2	-74.2	-71.8	-71.1	-69.3	+25	146.2	142.2	139.8	139.1	137.3
64QAM 0.92 single	-76.8	-73.1	-71.3	-70.0	-67.7	+25	144.8	141.1	139.3	138.0	135.7
64QAM 0.92 dual	-73.2	-69.4	-67.6	-66.9	-65.0	+25	141.2	137.4	135.6	134.9	133.0
256QAM 0.81 single	Not supported				-65.3	+25	Not supported				133.2
256QAM 0.81 dual					-62.2	+25					130.2

Table 64 PTP 45600 - TDM mode - threshold, power and link loss

Modulation mode	System threshold (dBm) per channel bandwidth					Output power (dBm)	Maximum link loss (dB) per channel bandwidth				
	5 MHz	10 MHz	15 MHz	20 MHz	30 MHz	All bands	5 MHz	10 MHz	15 MHz	20 MHz	30 MHz
BPSK 0.63 single	-96.6	-93.7	-92.0	-90.4	-88.0	+27	166.6	163.7	162.0	160.4	158.0
QPSK 0.63 single	-90.4	-89.1	-87.8	-86.0	-83.1	+27	158.1	155.4	153.3	151.6	149.5
QPSK 0.87 single	-88.1	-85.4	-83.3	-81.6	-79.5	+27	160.3	159.1	157.8	156.0	153.1
16QAM 0.63 single	-86.1	-82.8	-80.7	-79.2	-77.2	+27	156.1	152.8	150.7	149.2	147.2
16QAM 0.63 dual	-82.5	-79.1	-77.2	-75.6	-73.9	+27	152.5	149.1	147.2	145.6	143.9
16QAM 0.87 single	-81.2	-78.2	-76.1	-74.4	-72.0	+27	151.2	148.2	146.1	144.4	142.0
16QAM 0.87 dual	-77.7	-74.4	-72.4	-70.8	-69.2	+27	147.7	144.4	142.4	140.8	139.2
64QAM 0.75 single	-77.7	-74.5	-72.4	-70.7	-68.6	+25	145.7	142.5	140.4	138.7	136.6
64QAM 0.75 dual	-74.2	-70.9	-69.1	-67.5	-65.9	+25	142.2	138.9	137.1	135.5	133.9
64QAM 0.92 single	-75.9	-72.2	-70.2	-68.6	-66.5	+25	143.9	140.2	138.2	136.6	134.5
64QAM 0.92 dual	-71.7	-68.5	-66.8	-65.4	-63.7	+25	139.7	136.5	134.8	133.4	131.7
256QAM 0.81 single	Not supported				-64.9	+25	Not supported				132.9
256QAM 0.81 dual					-61.9	+25					129.9

Table 65 PTP 48600 - IP mode - threshold, power and link loss

Modulation mode	System Threshold (dBm) per channel bandwidth				Output power (dBm)		Maximum link loss (dB) per channel bandwidth			
	5 MHz	10 MHz	15 MHz	20 MHz	5, 10, 15 MHz	20 MHz	5 MHz	10 MHz	15 MHz	20 MHz
BPSK 0.63 single	-98.6	-95.5	-93.3	-91.9	+27	+27	169.6	166.5	164.3	162.9
QPSK 0.63 single	-94.3	-90.7	-89.6	-87.5	+27	+27	165.3	161.7	160.6	158.5
QPSK 0.87 single	-90.8	-87.3	-85.9	-84.0	+27	+26	161.8	158.3	156.9	154.0
16QAM 0.63 single	-88.7	-85.2	-83.6	-81.8	+25	+25	157.7	154.2	152.6	150.8
16QAM 0.63 dual	-85.3	-81.6	-80.0	-78.5	+25	+25	154.3	150.6	149.0	147.5
16QAM 0.87 single	-84.4	-80.6	-78.8	-77.3	+25	+25	153.4	149.6	147.8	146.3
16QAM 0.87 dual	-81.0	-77.2	-75.9	-74.5	+25	+25	150.0	146.2	144.9	143.5
64QAM 0.75 single	-81.2	-77.7	-76.1	-74.7	+23	+23	148.2	144.7	143.1	141.7
64QAM 0.75 dual	-78.2	-74.7	-73.4	-71.9	+23	+23	145.2	141.7	140.4	138.9
64QAM 0.92 single	-77.0	-73.9	-72.7	-71.0	+21	+21	142.0	138.9	137.7	136.0
64QAM 0.92 dual	-74.0	-70.9	-69.7	-67.6	+21	+21	139.0	135.9	134.7	132.6
256QAM 0.81 single	-75.2	-71.9	-70.1	-68.0	+20	+20	139.2	135.9	134.1	132.0
256QAM 0.81 dual	-72.1	-68.4	-66.9	-64.5	+20	+20	136.1	132.4	130.9	128.5

Table 66 PTP 48600 - TDM mode - threshold, power and link loss

Modulation Mode	System Threshold (dBm) per channel bandwidth				Output power (dBm)		Maximum link loss (dB) per channel bandwidth			
	5 MHz	10 MHz	15 MHz	20 MHz	5, 10, 15 MHz	20 MHz	5 MHz	10 MHz	15 MHz	20 MHz
BPSK 0.63 single	-98.6	-95.5	-93.3	-91.9	+27	+27	169.6	166.5	164.3	162.9
QPSK 0.63 single	-91.4	-88.8	-87.8	-85.7	+27	+27	162.4	159.8	158.8	156.7
QPSK 0.87 single	-87.9	-85.2	-83.5	-81.9	+27	+26	158.9	156.2	154.5	151.9
16QAM 0.63 single	-85.4	-82.7	-81.1	-79.6	+25	+25	154.4	151.7	150.1	148.6
16QAM 0.63 dual	-81.9	-79.5	-77.8	-76.5	+25	+25	150.9	148.5	146.8	145.5
16QAM 0.87 single	-81.0	-78.2	-76.8	-75.5	+25	+25	150.0	147.2	145.8	144.5
16QAM 0.87 dual	-77.8	-75.4	-74.0	-72.5	+25	+25	146.8	144.4	143.0	141.5
64QAM 0.75 single	-77.9	-75.2	-73.9	-72.6	+23	+23	144.9	142.2	140.9	139.6
64QAM 0.75 dual	-75.0	-72.6	-71.1	-69.3	+23	+23	142.0	139.6	138.1	136.3
64QAM 0.92 single	-76.5	-73.9	-72.3	-70.7	+21	+21	141.5	138.9	137.3	135.7
64QAM 0.92 dual	-73.3	-71.0	-69.0	-67.2	+21	+21	138.3	136.0	134.0	132.2
256QAM 0.81 single	-75.1	-72.3	-70.8	-69.3	+20	+20	139.1	136.3	134.8	133.3
256QAM 0.81 dual	-71.7	-69.3	-67.3	-65.4	+20	+20	135.7	133.3	131.3	129.4

Table 67 PTP 49600 - IP mode - threshold, power and link loss

Modulation mode	System threshold (dBm) per channel bandwidth			Output power (dBm)	Maximum link loss (dB) per channel bandwidth		
	5 MHz	10 MHz	20 MHz	All bands	5 MHz	10 MHz	20 MHz
BPSK 0.63 single	-98.6	-95.5	-91.9	+24	166.6	163.5	159.9
QPSK 0.63 single	-94.3	-90.7	-87.5	+24	162.3	158.7	155.5
QPSK 0.87 single	-90.8	-87.3	-84.0	+24	158.8	155.3	152.0
16QAM 0.63 single	-88.7	-85.2	-81.8	+24	156.7	153.2	149.8
16QAM 0.63 dual	-85.3	-81.6	-78.5	+24	153.3	149.6	146.5
16QAM 0.87 single	-84.4	-80.6	-77.3	+24	152.4	148.6	145.3
16QAM 0.87 dual	-81.0	-77.2	-74.5	+24	149.0	145.2	142.5
64QAM 0.75 single	-81.2	-77.7	-74.7	+23	148.2	144.7	141.7
64QAM 0.75 dual	-78.2	-74.7	-71.9	+23	145.2	141.7	138.9
64QAM 0.92 single	-77.0	-73.9	-71.0	+21	142.0	138.9	136.0
64QAM 0.92 dual	-74.0	-70.9	-67.6	+21	139.0	135.9	132.6
256QAM 0.81 single	-75.2	-71.9	-68.0	+20	139.2	135.9	132.0
256QAM 0.81 dual	-72.1	-68.4	-64.5	+20	136.1	132.4	128.5

Table 68 PTP 49600 - TDM mode - threshold, power and link loss

Modulation mode	System threshold (dBm) per channel bandwidth			Output power (dBm)	Maximum link loss (dB) per channel bandwidth		
	5 MHz	10 MHz	20 MHz	All bands	5 MHz	10 MHz	20 MHz
BPSK 0.63 single	-98.6	-95.5	-91.9	+24	166.6	163.5	159.9
QPSK 0.63 single	-91.4	-88.8	-85.7	+24	159.4	156.8	153.7
QPSK 0.87 single	-87.9	-85.2	-81.9	+24	155.9	153.2	149.9
16QAM 0.63 single	-85.4	-82.7	-79.6	+24	153.4	150.7	147.6
16QAM 0.63 dual	-81.9	-79.5	-76.5	+24	149.9	147.5	144.5
16QAM 0.87 single	-81.0	-78.2	-75.5	+24	149.0	146.2	143.5
16QAM 0.87 dual	-77.8	-75.4	-72.5	+24	145.8	143.4	140.5
64QAM 0.75 single	-77.9	-75.2	-72.6	+23	144.9	142.2	139.6
64QAM 0.75 dual	-75.0	-72.6	-69.3	+23	142.0	139.6	136.3
64QAM 0.92 single	-76.5	-73.9	-70.7	+21	141.5	138.9	135.7
64QAM 0.92 dual	-73.3	-71.0	-67.2	+21	138.3	136.0	132.2
256QAM 0.81 single	-75.1	-72.3	-69.3	+20	139.1	136.3	133.3
256QAM 0.81 dual	-71.7	-69.3	-65.4	+20	135.7	133.3	129.4

Table 69 PTP 54600 - IP mode - threshold, power and link loss

Modulation mode	System threshold (dBm) per channel bandwidth				Output power (dBm)	Maximum link loss (dB) per channel bandwidth			
	5 MHz	10 MHz	15 MHz	30 MHz	All bands	5 MHz	10 MHz	15 MHz	30 MHz
BPSK 0.63 single	-98.2	-94.6	-92.3	-88.9	+25	169.2	165.6	163.3	159.9
QPSK 0.63 single	-93.0	-90.0	-88.5	-82.9	+24	163.0	160.0	158.5	152.9
QPSK 0.87 single	-90.2	-86.7	-85.3	-80.1	+23	159.2	155.7	154.3	149.1
16QAM 0.63 single	-88.0	-83.8	-82.8	-78.3	+22	156.0	151.8	150.8	146.3
16QAM 0.63 dual	-84.3	-80.7	-79.3	-74.6	+22	152.3	148.7	147.3	142.6
16QAM 0.87 single	-82.4	-79.1	-78.2	-73.0	+20	148.4	145.1	144.2	139.0
16QAM 0.87 dual	-79.7	-75.7	-74.7	-70.6	+20	145.7	141.7	140.7	136.6
64QAM 0.75 single	-78.9	-76.4	-74.9	-70.3	+18	142.9	140.4	138.9	134.3
64QAM 0.75 dual	-76.5	-72.7	-71.6	-67.7	+18	140.5	136.7	135.6	131.7
64QAM 0.92 single	-74.4	-71.7	-70.4	-65.0	+18	138.4	135.7	134.4	129.0
64 QAM 0.92 dual	-70.7	-68.5	-66.9	-62.3	+18	134.7	132.5	130.9	126.3
256QAM 0.81 single	N/A	N/A	N/A	-63.6	+18	N/A	N/A	N/A	127.6
256QAM 0.81 dual	N/A	N/A	N/A	-60.5	+18	N/A	N/A	N/A	124.5

Table 70 PTP 54600 - TDM mode - threshold, power and link loss

Modulation mode	System threshold (dBm) per channel bandwidth				Output power (dBm)	Maximum link loss (dB) per channel bandwidth			
	5 MHz	10 MHz	15 MHz	30 MHz	All bands	5 MHz	10 MHz	15 MHz	30 MHz
BPSK 0.63 single	-98.2	-94.6	-92.3	-88.9	+25	169.2	165.6	163.3	159.9
QPSK 0.63 single	-89.7	-88.3	-86.4	-81.4	+24	159.7	158.3	156.4	151.4
QPSK 0.87 single	-86.7	-84.3	-82.3	-78.4	+23	155.6	153.3	151.3	147.4
16QAM 0.63 single	-86.6	-81.8	-79.9	-76.0	+22	151.7	149.8	147.9	144.0
16QAM 0.63 dual	-83.7	-78.2	-76.5	-72.4	+22	148.8	146.3	144.5	140.4
16QAM 0.87 single	-78.8	-76.6	-75.5	-69.8	+20	144.8	142.6	141.5	135.8
16QAM 0.87 dual	-76.9	-73.9	-72.2	-68.7	+20	142.9	139.9	138.2	134.7
64QAM 0.75 single	-74.7	-72.2	-71.8	-66.6	+18	138.7	136.2	135.8	130.6
64QAM 0.75 dual	-73.0	-70.4	-68.8	-65.6	+18	137.0	134.4	132.8	129.6
64QAM 0.92 single	-70.9	-68.6	-67.4	-62.9	+18	134.9	132.6	131.4	126.9
64 QAM 0.92 dual	-68.2	-65.6	-64.2	-60.5	+18	132.1	129.6	128.2	124.5
256QAM 0.81 single	N/A	N/A	N/A	-65.4	+18	N/A	N/A	N/A	126.9
256QAM 0.81 dual	N/A	N/A	N/A	-60.5	+18	N/A	N/A	N/A	124.5

Table 71 PTP 58600 - IP mode - threshold, power and link loss

Modulation mode	System threshold (dBm) per channel bandwidth				Output power (dBm)	Maximum link loss (dB) per channel bandwidth			
	5 MHz	10 MHz	15 MHz	30 MHz	All bands	5 MHz	10 MHz	15 MHz	30 MHz
BPSK 0.63 single	-95.1	-92.5	-90.8	-86.3	+25	166.1	163.5	161.8	157.3
QPSK 0.63 single	-91.9	-90.0	-87.7	-83.0	+24	161.9	160.0	157.7	153.0
QPSK 0.87 single	-88.7	-86.6	-84.8	-80.3	+23	157.7	155.6	153.8	149.3
16QAM 0.63 single	-86.0	-84.3	-82.4	-78.3	+22	154.0	152.3	150.4	146.3
16QAM 0.63 dual	-83.5	-80.4	-78.5	-75.3	+22	151.5	148.4	146.5	143.3
16QAM 0.87 single	-82.1	-79.5	-78.1	-72.5	+20	148.1	145.5	144.1	138.5
16QAM 0.87 dual	-79.2	-76.2	-73.9	-71.5	+20	145.2	142.2	139.9	137.5
64QAM 0.75 single	-78.8	-76.7	-75.2	-69.2	+18	142.8	140.7	139.2	133.2
64QAM 0.75 dual	-76.1	-73.1	-71.0	-67.7	+18	140.1	137.1	135.0	131.7
64QAM 0.92 single	-74.4	-72.5	-66.2	-65.0	+18	138.4	136.5	134.6	129.0
64 QAM 0.92 dual	-70.2	-69.1	-70.7	-61.5	+18	134.2	133.1	130.2	125.5
256QAM 0.81 single	N/A	N/A	N/A	-64.0	+18	N/A	N/A	N/A	128.0
256QAM 0.81 dual	N/A	N/A	N/A	-59.6	+18	N/A	N/A	N/A	123.6

Table 72 PTP 58600 - TDM mode - threshold, power and link loss

Modulation mode	System threshold (dBm) per channel bandwidth				Output power (dBm)	Maximum link loss (dB) per channel bandwidth			
	5 MHz	10 MHz	15 MHz	30 MHz	All bands	5 MHz	10 MHz	15 MHz	30 MHz
BPSK 0.63 single	-95.1	-92.5	-90.8	-86.3	+25	166.1	163.5	161.8	157.3
QPSK 0.63 single	-88.7	-87.8	-86.0	-80.6	+24	158.7	157.8	155.9	150.6
QPSK 0.87 single	-85.5	-83.8	-81.6	-77.8	+23	154.5	152.8	150.6	146.8
16QAM 0.63 single	-82.0	-81.3	-79.1	-75.3	+22	150.0	149..3	147.1	143.3
16QAM 0.63 dual	-79.4	-77.6	-75.6	-71.7	+22	147.4	145.6	143.6	139.7
16QAM 0.87 single	-78.7	-76.3	-74.7	-71.2	+20	144.7	142.3	140.7	137.2
16QAM 0.87 dual	-75.1	-73.2	-71.0	-67.7	+20	141.0	139.2	137.0	133.7
64QAM 0.75 single	-74.4	-72.3	-70.6	-67.9	+18	138.4	136.3	134.6	131.9
64QAM 0.75 dual	-70.9	-69.5	-67.6	-64.0	+18	134.9	133.5	131.6	128.0
64QAM 0.92 single	-70.9	-68.0	-66.6	-63.1	+18	134.9	132.0	130.6	127.1
64 QAM 0.92 dual	-66.8	-64.6	-65.5	-58.7	+18	130.8	128.6	126.5	122.7
256QAM 0.81 single	N/A	N/A	N/A	-63.1	+18	N/A	N/A	N/A	127.1
256QAM 0.81 dual	N/A	N/A	N/A	-58.7	+18	N/A	N/A	N/A	122.7

Table 73 PTP 59600 - IP mode - threshold, power and link loss

Modulation mode	System threshold (dBm) per channel bandwidth				Output power (dBm)	Maximum link loss (dB) per channel bandwidth			
	5 MHz	10 MHz	15 MHz	30 MHz	All bands	5 MHz	10 MHz	15 MHz	30 MHz
BPSK 0.63 single	-97.1	-94.1	-92.0	-88.7	+25.0	168.1	165.1	163.0	159.7
QPSK 0.63 single	-90.7	-88.1	-87.1	-82.5	+24.0	160.7	158.1	157.1	152.5
QPSK 0.87 single	-87.2	-84.4	-83.5	-79.3	+23.0	156.2	153.4	152.5	148.3
16QAM 0.63 single	-85.0	-81.9	-81.2	-77.1	+22.0	153.0	149.9	149.2	145.1
16QAM 0.63 dual	-81.9	-78.8	-77.5	-73.5	+22.0	149.9	146.8	145.5	141.5
16QAM 0.87 single	-80.9	-78.0	-76.7	-72.9	+20.0	146.9	143.9	142.7	138.9
16QAM 0.87 dual	-76.5	-73.9	-73.2	-70.0	+20.0	142.5	139.9	139.2	136.0
64QAM 0.75 single	-77.0	-74.6	-73.6	-70.3	+18.0	141.0	138.6	137.6	134.3
64QAM 0.75 dual	-73.1	-71.0	-70.4	-67.5	+18.0	137.1	135.0	134.4	131.5
64QAM 0.92 single	-72.1	-71.0	-68.9	-65.7	+18.0	136.1	135.0	132.9	129.7
64 QAM 0.92 dual	-70.2	-67.2	-66.1	-62.1	+18.0	134.2	131.1	130.1	126.1
256QAM 0.81 single	N/A	N/A	N/A	-63.9	+18.0	N/A	N/A	N/A	127.9
256QAM 0.81 dual	N/A	N/A	N/A	-59.9	+18.0	N/A	N/A	N/A	123.9

Table 74 PTP 59600 - TDM mode - threshold, power and link loss

Modulation mode	System threshold (dBm) per channel bandwidth				Output power (dBm)	Maximum link loss (dB) per channel bandwidth			
	5 MHz	10 MHz	15 MHz	30 MHz	All bands	5 MHz	10 MHz	15 MHz	30 MHz
BPSK 0.63 single	-97.1	-94.1	-92.0	-88.7	+25.0	168.1	165.1	163.0	159.7
QPSK 0.63 single	-88.5	-86.1	-84.4	-79.4	+24.0	158.5	156.1	154.4	149.4
QPSK 0.87 single	-84.6	-81.9	-80.1	-76.0	+23.0	153.6	150.9	149.1	145.0
16QAM 0.63 single	-82.5	-79.6	-77.8	-73.7	+22.0	150.4	147.6	145.8	141.7
16QAM 0.63 dual	-78.8	-76.0	-74.1	-70.4	+22.0	146.8	144.0	142.1	138.4
16QAM 0.87 single	-78.3	-75.1	-73.7	-70.2	+20.0	144.3	141.1	139.7	136.2
16QAM 0.87 dual	-74.2	-71.6	-70.2	-66.9	+20.0	140.2	137.6	134.2	132.9
64QAM 0.75 single	-74.7	-71.4	-70.2	-67.3	+18.0	138.7	135.4	134.2	131.3
64QAM 0.75 dual	-70.9	-68.3	-66.8	-63.6	+18.0	134.8	132.2	130.8	127.6
64QAM 0.92 single	-71.2	-68.1	-67.0	-63.3	+18.0	135.2	132.0	131.0	127.3
64 QAM 0.92 dual	-66.7	-64.2	-62.7	-58.7	+18.0	130.7	128.2	126.7	122.7
256QAM 0.81 single	N/A	N/A	N/A	-63.3	+18.0	N/A	N/A	N/A	127.3
256QAM 0.81 dual	N/A	N/A	N/A	-58.7	+18.0	N/A	N/A	N/A	122.7

Data network specifications

This section contains specifications of the PTP 600 Ethernet and telecoms interfaces.

Ethernet and telecoms interfaces

The PTP 600 Ethernet ports conform to the specifications listed in Table 75 and Table 76.

Table 75 PTP 600 Ethernet bridging specifications

Ethernet Bridging	Specification
Protocol	IEEE802.1; IEEE802.1p; IEEE802.3 compatible
QoS	IEEE 802.1p (eight levels), IEEE 802.1Q, IEEE 802.1ad, DSCP IPv4, DSCP IPv6, MPLS TC
Interface	10/100/1000BaseT (RJ-45), Supports MDI/MDIX Auto Crossover
Data Rates	See Data throughput tables on page 4-74.
Maximum Ethernet Frame Size	2000 bytes
Service classes for bridged traffic	7 classes (out-of-band management mode) 8 classes (in-band management mode)

NOTE

Practical Ethernet rates will depend on network configuration, higher layer protocols and platforms used.

Over the air throughput will be capped to the rate of the Ethernet interface at the receiving end of the link.

Table 76 PTP 600 telecoms interface specifications

Telecoms	Specification
Interfaces	2 E1 balanced 120R or 2 T1 balanced 100R over a CAT5 screened twisted pair cable.
Jitter and Wander	Compliant with G.823/ G.824.
Surge Protection and Power Cross	Compliant with GR1089, EN60950.

Layer 2 control protocols

PTP 600 identifies Layer 2 control protocols by inspecting the Ethernet destination address of each bridged frame (Table 77).

Table 77 Destination address in layer 2 control protocols

Destination address	Protocol
01-80-c2-00-00-00 to 01-80-c2-00-00-0f	IEEE 802.1 bridge protocols
01-80-c2-00-00-20 to 01-80-c2-00-00-2f	IEEE 802.1 Multiple Registration Protocol (MRP)
01-80-c2-00-00-30 to 01-80-c2-00-00-3f	IEEE 802.1ag, Connectivity Fault Management (CFM)
01-19-a7-00-00-00 to 01-19-a7-00-00-ff	Ring Automatic Protection Switching (R-APS)
00-e0-2b-00-00-04	Ethernet Automatic Protection Switching (EAPS)

Syslog message formats

This section describes the format and content of syslog messages.

Format of syslog server messages

PTP 600 generates syslog messages in this format:

```
SP = “ ” = %x20
CO = “:” = %x3A
SC = “;” = %x3B
LT = “<” = %x3C
GT = “>” = %x3E
syslog = pri header SP message
pri = LT “1”-“182” GT
header = timestamp SP hostname
timestamp = month SP days SP hours “:” minutes “:” seconds
month =
“Jan”|“Feb”|“Mar”|“Apr”|“May”|“Jun”|“Jul”|“Aug”|“Sep”|“Oct”|“Nov”|“Dec”
days = “ 1”-“31”
hours = “00”-“23”
minutes = seconds = “00”-“59”
hostname = “0.0.0.0”-“255.255.255.255”
message = “PTP600” CO SP (configuration | status | event)
configuration = “configuration” SC SP attribute-name SC SP (“Web
user”|“SNMP user”|“SNTP”) SC SP “was=” previous-value SC SP “now=” new-
value SC
status = “status” SC SP attribute-name SC SP “was=” previous-value SC SP
“now=” new-value SC
event = “event” SC SP identifier SC SP event-message-content SC
```

Configuration and status messages

Configuration and status messages contain all of the relevant attributes.

This is an example of a configuration message:

```
PTP600: configuration; IP Address; Web user; was=10.10.10.10;
now=169.254.1.1;
```

This is an example of a status message:

```
PTP600: status; Data Port Status; was=Down; now=Up;
```

Event messages

Event messages are listed in Table 78. Definition of abbreviations:

SC = ";"

SP = " "

This is an example of an event message:

```
PTP600: event; auth_login; web user=MarkT; from=169.254.1.1; port=80;
connection=HTTP; authentication=local;
```

Table 78 Event messages

Facility	Severity	Identifier	Message content
security(4)	warning(4)	auth_idle	"Web user=" user-name SC SP "from=" IP-address SC SP "port=" port-number SC SP "connection=" ("HTTP" | "HTTPS") SC SP "authentication=" ("local" | "RADIUS") SC
security(4)	info(6)	auth_login	
security(4)	warning(4)	auth_login_failed	
security(4)	warning(4)	auth_login_locked	
security(4)	info(6)	auth_logout	
kernel(0)	warning(4)	cold_start	"PTP wireless bridge has reinitialized, reason=" reset-reason SC
security(4)	warning(4)	License_update	"License Key updated" SC
syslog(5)	warning(4)	log_full	"Syslog local flash log is 90% full" SC
syslog(5)	warning(4)	log_wrap	"Syslog local flash log has wrapped" SC
security(4)	info(6)	radius_auth	"RADIUS user=" user-name SC SP "server " ("1" | "2") " at " IP-address SP "succeeded" SC
security(4)	warning(4)	radius_auth_fail	"RADIUS user=" user-name SC SP "server " ("1" | "2") " at " IP-address SP ("failed" | "succeeded" | "failed (no response)") SC
security(4)	alert(1)	resource_low	"Potential DoS attack on packet ingress " ("warning" | "cleared") SC
security(4)	warning(4)	sec_zeroize	"Critical Security Parameters (CSPs) zeroized" SC
local6(22)	warning(4)	snmpv3_asn1	"ASN.1 parse error" SC
security(4)	warning(4)	snmpv3_auth	"Authentication failure" SC

Facility	Severity	Identifier	Message content
local6(22)	warning(4)	snmpv3_decryption	"Decryption failure" SC
local6(22)	warning(4)	snmpv3_engine_id	"Unknown engine ID" SC
local6(22)	warning(4)	snmpv3_sec_level	"Unknown security level" SC
kernel(0)	warning(4)	sys_reboot	"System Reboot, reason=" reset-reason SC
security(4)	warning(4)	sys_software _upgrade	"Software upgraded from " software-version " to " software-version SC software-version = ("25600" | "45600" | "48600" | "49600" | "54600" | "58600" | "59600") digit digit "-" digit digit ("" | "-FIPS" | "-UCAPL") SC
local6(22)	warning(4)	telnet_idle	"Telnet user=" user-name SC SP "from=" IP-address SC SP "port=" port-number SC
local6(22)	info(6)	telnet_login	
local6(22)	warning(4)	telnet_login_failed	
local6(22)	info(6)	telnet_logout	
local6(22)	info(6)	tftp_complete	"TFTP software upgrade finished" SC
local6(22)	info(6)	tftp_failure	"TFTP software upgrade failed, reason=" reason SC
local6(22)	info(6)	tftp_start	"TFTP software upgrade started" SC
NTP(12)	info(6)	time_auth	"SNTP authentication succeeded at IP-address=" IP-address SC SP "port-number=" port SC
NTP(12)	warning(4)	time_auth_failed	"SNTP authentication failed at IP-address=" IP-address SC SP "port-number=" port SC
NTP(12)	warning(4)	time_conn_failed	"SNTP connection failed at IP-address=" IP-address SC SP "port-number=" port SC SP "reason=" reason SC

Compliance with safety standards

This section lists the safety specifications against which the PTP 600 has been tested and certified. It also describes how to keep RF exposure within safe limits.

Electrical safety compliance

The PTP 600 hardware has been tested for compliance to the electrical safety specifications listed in Table 79.

Table 79 PTP 600 safety compliance specifications

Region	Specification
USA	UL 60950
Canada	CSA C22.2 No.60950
International	CB certified & certificate to IEC 60950

Electromagnetic compatibility (EMC) compliance

The PTP 600 complies with European EMC Specification EN301 489-1 with testing carried out to the detailed requirements of EN301 489-4.

NOTE

For EN 61000-4-2: 1995 Electro Static Discharge (ESD), Class 2, 8 kV air, 4 kV contact discharge, the PTP 600 has been tested to ensure immunity to 15 kV air and 8 kV contact.

Table 80 lists the EMC specification type approvals that have been granted for PTP 600 frequency variants.

Table 80 EMC emissions compliance

Variant	Region	Specification (Type Approvals)
PTP 25600	USA	FCC Part 15 (Class B)
PTP 45600	US Federal	
PTP 48600	US Federal	
PTP 49600	USA	FCC Part 15B
PTP 54600	USA	FCC Part 15 Class B
	Canada	RSS Gen and RSS 210
	Europe	EN55022 CISPR 22
PTP 58600	USA	FCC Part 15 Class B
	Canada	RSS Gen and RSS 210
	Europe	EN55022 CISPR 22

Human exposure to radio frequency energy

Standards

Relevant standards (USA and EC) applicable when working with RF equipment are:

- ANSI IEEE C95.1-1991, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.
- Council recommendation of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) (1999/519/EC) and respective national regulations.
- *Directive 2004/40/EC of the European Parliament and of the Council of 29 April 2004* on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields) (18th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC).

- US FCC limits for the general population. See the FCC web site at http://www.fcc.gov, and the policies, guidelines, and requirements in Part 1 of Title 47 of the Code of Federal Regulations, as well as the guidelines and suggestions for evaluating compliance in FCC OET Bulletin 65.
- Health Canada limits for the general population. See the Health Canada web site at http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/99ehd-dhm237/limits-limites_e.html and Safety Code 6.
- EN 50383:2002 Basic standard for the calculation and measurement of electromagnetic field strength and SAR related to human exposure from radio base stations and fixed terminal stations for wireless telecommunication systems (110 MHz - 40 GHz).
- BS EN 50385:2002 Product standard to demonstrate the compliances of radio base stations and fixed terminal stations for wireless telecommunication systems with the basic restrictions or the reference levels related to human exposure to radio frequency electromagnetic fields (110 MHz – 40 GHz) – general public.
- ICNIRP (International Commission on Non-Ionizing Radiation Protection) guidelines for the general public. See the ICNIRP web site at http://www.icnirp.de/ and Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields.

Power density exposure limit

Install the radios for the PTP 600 family of PTP wireless solutions so as to provide and maintain the minimum separation distances from all persons.

The applicable power density exposure limit from the standards (see Human exposure to radio frequency energy on page 4-52) is:

10 W/m² for RF energy in the 2.4-, 5.2-, 5.4-, 5.8- and 5.9 GHz frequency bands.

Calculation of power density

NOTE

The following calculation is based on the ANSI IEEE C95.1-1991 method, as that provides a worst case analysis. Details of the assessment to EN50383:2002 can be provided, if required.

Peak power density in the far field of a radio frequency point source is calculated as follows:

$$S = \frac{P.G}{4\pi d^2}$$

Where:	Is:
S	power density in W/m^2
P	maximum average transmit power capability of the radio, in W
G	total Tx gain as a factor, converted from dB
d	distance from point source, in m

Rearranging terms to solve for distance yields:

$$d = \sqrt{\frac{P.G}{4\pi.S}}$$

Calculated distances and power compliance margins

Table 81 shows calculated minimum separation distances, recommended distances and resulting margins for each frequency band and antenna combination. These are conservative distances that include compliance margins. At these and greater separation distances, the power density from the RF field is below generally accepted limits for the general population.

Explanation of terms used in Table 81:

Tx burst – maximum average transmit power in burst (Watt)

P – maximum average transmit power capability of the radio (Watt)

G – total transmit gain as a factor, converted from dB

S – power density (W/m^2)

d – minimum distance from point source (meters)

R – recommended distances (meters)

C – compliance factor

Table 81 Power compliance margins

Band	Antenna	Tx burst (W)	P (W)	G	S (W/m^2)	d (m)	R (m)	C
2.5 GHz	Integrated	0.25	0.2	63	10	0.32	2	6.0
4.5 GHz	Integrated	0.5	0.4	158	10	0.71	5	7.0
4.8 GHz	Integrated	0.5	0.4	158	10	0.71	5	7.0
	Connectorized	0.5	0.4	398	10	1.1	5	4.5
4.9 GHz	Integrated	0.25	0.2	158	10	0.5	2	4.0
	Connectorized	0.25	0.2	398	10	0.8	5	6.25
5.4 GHz	Integrated	0.005	0.004	200	10	0.08	1	12.5
	External 4ft Dish	0.00035	0.00028	2884	10	0.08		
5.8 GHz	Integrated	0.32	0.26	200	10	0.63	2	3.2
	External 2ft Flat Plate	0.32	0.26	631	10	1.0	5	5.0
	External 6ft Dish	0.32	0.26	6310	10	3.07	10	3.25
	External sectored antenna (60°)	0.32	0.26	50.1	10	0.28	1	3.6
5.9 GHz	Integrated	0.32	0.16	200	10	0.63	2	4.0
	External 2ft Flat Plate	0.32	0.16	631	10	1.0	5	5.0
	External 6ft Dish	0.32	0.16	6310	10	3.07	10	3.25

NOTE

Gain of antenna in dBi = 10*log(G).

The regulations require that the power used for the calculations is the maximum power in the transmit burst subject to allowance for source-based time-averaging.

At 5.4 GHz and EU 5.8 GHz, the products are generally limited to a fixed EIRP which can be achieved with the Integrated Antenna. The calculations above assume that the maximum EIRP allowed by the regulations is being transmitted.

NOTE

If there are no EIRP limits in the country of deployment, use the distance calculations for FCC 5.8 GHz for all frequency bands.

At FCC 5.8 GHz, for antennas between 0.6m (2ft) and 1.8m (6ft), alter the distance proportionally to the antenna gain.

At 2.5 GHz, for antennas between 1.2m (4ft) and 3.6m (12ft) the safe distance is increased to between 0.8m (2.6 ft) and 2.4m (7.8 ft).

Hazardous location compliance

The PTP600-ATEX/Hazloc Series radio products have been certified for operation in the following hazardous locations:

ATEX

The products have been approved under an 'Intrinsic Safety' assessment as defined in EN60079-11:2007.

The approval is given by certificate number TRAC09ATEX31224X, issued by TRaC Global, with the specific level of coverage shown below.

II 3 G Ex ic IIC T4

II - Equipment group (surface applications)

3 - Equipment category (infrequent exposure)

G - Atmosphere (Gas)

ic - Protection concept (intrinsic safety)

IIC - Gas group (up to and including Hydrogen and Acetylene)

T4 - Temperature class (135°C)

Hazloc

The products have been assessed and found compliant with the requirements of UL1604 and CSA C22.2 No. 213 for the following conditions.

The approval is given by MET Labs under File Reference E113068, with the specific level of coverage shown below.

Complies with UL1604 and CSA C22.2 No. 213

Class I - Gases, Vapors and Liquids (surface applications)

Div – 2 (Infrequent Exposure)

Gas Groups - A, B, C, D (up to and including Hydrogen and Acetylene)

Operating Temperature Code - T4 (135°C)

Compliance with radio regulations

This section describes how the PTP 600 complies with the radio regulations that are in force in various countries.

⚠ CAUTION

Changes or modifications not expressly approved by Cambium could void the user's authority to operate the system.

Type approvals

This system has achieved Type Approval in various countries around the world. This means that the system has been tested against various local technical regulations and found to comply. The frequency bands in which the system operates may be 'unlicensed' and, in these bands, the system can be used provided it does not cause interference. The system is not guaranteed protection against interference from other products and installations.

Table 80 lists the radio specification type approvals that have been granted for PTP 600 frequency variants.

Table 82 Radio certifications

Variant	Region	Specification (Type Approvals)
PTP 49600	USA	FCC Part 90
	Canada	RSS-111
PTP 54600	USA	FCC Part 15 E
	Canada	RSS 210 Issue 7, Annex 9
	Europe	EN301 893 V1.5.1 with DFS testing using radar parameters
PTP 58600	USA	FCC Part 15.247
	CANADA	RSS 210 Issue 7, Annex 8
	UK	IR 2007
	Eire	ComReg 02/71R1
	EU	EN302 502 v 1.2.1

FCC and ETSI compliance testing (without PTP-SYNC)

Without PTP-SYNC installed, the system has been tested for compliance to both US (FCC) and European (ETSI) specifications. It has been shown to comply with the limits for emitted spurious radiation for a Class B digital device, pursuant to Part 15 of the FCC Rules in the USA and appropriate European ENs. These limits have been designed to provide reasonable protection against harmful interference. However the equipment can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to other radio communications. There is no guarantee that interference will not occur in a particular installation.

NOTE

A Class B Digital Device is a device that is marketed for use in a residential environment, notwithstanding use in commercial, business and industrial environments.

NOTE

Notwithstanding that Cambium has designed (and qualified) the PTP 600 products to generally meet the Class B requirement to minimize the potential for interference, the PTP 600 product range is not marketed for use in a residential environment.

FCC and ETSI compliance testing (with PTP-SYNC)

With PTP-SYNC installed, this equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules and with RSS-GEN of Industry Canada. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

NOTE

A Class A Digital Device is a device that is marketed for use in a commercial, industrial or business environment, exclusive of a device which is marketed for use by the general public or is intended to be used in the home.

Examples of regulatory limits

Examples of the regulatory limits that apply in typical regions of operation are in the following tables:

- Table 83 - PTP 25600
- Table 84 - PTP 45600
- Table 85 - PTP 48600
- Table 86 - PTP 49600
- Table 87 - PTP 54600
- Table 88 - PTP 58600
- Table 89 - PTP 59600

NOTE

In Canada, the EIRP limit in the 5470 - 5600 MHz and 5650 - 5725 MHz (5.4 GHz) band is 1.0 W or (17 + 10 $\log_{10}$ B) dBm, whichever power is less. B is the 99% emission bandwidth in MHz according to RSS 210 Annex 9.2 (3).

In Canada, NO operation is permitted in the band 5600 – 5650 MHz.

Table 83 Licenses and region codes for PTP 25600

Region code	License / regulation	Frequencies	DFS	Channel bandwidth	Maximum power
16	FCC Upper	2624 - 2690 MHz		5, 10, 15, 30 MHz (*1)	63 dBm EIRP (*2)
	FCC Middle	2572 - 2614 MHz		5, 10, 15, 30 MHz (*1)	63 dBm EIRP (*2)
	FCC Lower	2496 - 2568 MHz		5, 10, 15, 30 MHz (*1)	63 dBm EIRP (*2)
18	Taiwan Upper	2660 - 2690 MHz		5, 10, 15 MHz	23 dBm
	Taiwan Middle	2595 - 2625 MHz		5, 10, 15 MHz	23 dBm
	Taiwan Lower	2565 - 2595 MHz		5, 10, 15 MHz	23 dBm

(*1) Region code 16: the 30 MHz bandwidth is not approved for 2.5 GHz in FCC regions.

(*2) Region code 16: the EIRP limit is approximately 63 dBm + 10 x Log(360/Antenna Azimuth BW). PTP 25600 products are not able to exceed this EIRP limit with any available antenna.

Table 84 Licenses and region codes for PTP 45600

Region code	License / regulation	Frequencies	DFS	Channel bandwidth	Max power
23	US Federal	4400 - 4600 MHz		5, 10, 15, 20, 30 MHz	27 dBm
24	NTIA	4400 - 4600 MHz		10, 20, 30 MHz	27 dBm

Table 85 Licenses and region codes for PTP 48600

Region code	License / regulation	Frequencies	DFS	Channel bandwidth	Max power
14	USA/Canada Public Safety	4940 - 4990 MHz		5, 10, 20 MHz	24 dBm (*1)
15	US Federal Extended	4710 - 5000 MHz		5, 10, 15, 20 MHz	27 dBm
23	US Federal	4710 - 4940 MHz		5, 10, 15, 20 MHz	27 dBm
24	NTIA	4700 - 4940 MHz		10, 20 MHz	27 dBm

(*1) Region code 14: PTP 48600 Max Power depends upon Antenna Gain:

- If Antenna Gain < 26 dBi then Max Power = 24 dBm
- If Antenna Gain >= 26 dBi then Max Power = (50 – Antenna Gain) dBm

Table 86 Licenses and region codes for PTP 49600

Region code	License / regulation	Frequencies	DFS	Channel bandwidth	Max power
14	USA/Canada Public Safety	4940 - 4990 MHz		5, 10, 20 MHz	24 dBm (*1)
17	UK, Licence Required	4940 - 4990 MHz		5, 10, 20 MHz	22 dBm
18	Hong Kong Public Safety	4900 - 4950 MHz		5, 10, 20 MHz	24 dBm (*1)
19	EU Broadband Disaster Recove	4940 - 4990 MHz		5, 10, 20 MHz	(*2)

(*1) Region codes 14 and 18: PTP 49600 Max Power depends upon Antenna Gain:

- If Antenna Gain < 26 dBi then Max Power = 24 dBm
- If Antenna Gain >= 26 dBi then Max Power = (50 – Antenna Gain) dBm

(*2) Region code 19: Max Power depends upon Channel Bandwidth and Antenna Gain:

- If Channel Bandwidth = 5 MHz then Max Power = (32 – Antenna Gain) dBm
- If Channel Bandwidth = 10 MHz then Max Power = (35 – Antenna Gain) dBm
- If Channel Bandwidth = 20 MHz then Max Power = (37 – Antenna Gain) dBm

Table 87 Licenses and region codes for PTP 54600

Region code	License or regulation	Frequencies	DFS	Channel bandwidth	Max power
12	FCC USA, Mexico	5470 - 5725 MHz	Yes	30 MHz	30 dBm EIRP
				15 MHz	27 dBm EIRP
				10 MHz	25 dBm EIRP
				5 MHz	22 dBm EIRP
13	Canada, Australia	5470 - 5600 MHz 5650 - 5725 MHz (*1)	Yes	30 MHz	30 dBm EIRP
				15 MHz	27 dBm EIRP
				10 MHz	25 dBm EIRP
				5 MHz	22 dBm EIRP
20	Thailand	5470 - 5725 MHz		5, 10, 15, 30 MHz	30 dBm EIRP
21	Korea	5470 - 5650 MHz		15 MHz	27 dBm EIRP
				10 MHz	25 dBm EIRP
				5 MHz	22 dBm EIRP
26	ETSI	5470 - 5600 MHz 5650 - 5725 MHz (*1)	Yes	30 MHz	30 dBm EIRP
				15 MHz	27 dBm EIRP
				10 MHz	25 dBm EIRP
				5 MHz	22 dBm EIRP

(*1) Region codes 13 and 26: the band 5600 MHz to 5650 MHz is reserved for the use of weather radars.

Table 88 Licenses and region codes for PTP 58600

Region code	License / regulation	Frequencies	DFS	Channel bandwidth	Max power
1	FCC USA, Canada, Taiwan, Brazil	5725 - 5850 MHz (*2)		5, 10, 15 and 30 MHz	25 dBm
2	China	5725 - 5850 MHz		30 MHz	32 dBm EIRP
				15 MHz	29 dBm EIRP
				10 MHz	28 dBm EIRP
				5 MHz	25 dBm EIRP
3	Australia, Hong Kong, Mexico	5725 - 5850 MHz		5, 10, 15, 30 MHz	36 dBm EIRP
4	UK, Finland	5725 - 5795 MHz 5815 - 5850 MHz (*1)	Yes	30 MHz	35 dBm EIRP
				15 MHz	33 dBm EIRP
				10 MHz	31 dBm EIRP
				5 MHz	28 dBm EIRP
5	Singapore	5725 - 5850 MHz		5, 10, 15, 30 MHz	30 dBm EIRP
6	Eire	5725 - 5850 MHz		30 MHz	32 dBm EIRP
				15 MHz	29 dBm EIRP
				10 MHz	28 dBm EIRP
				5 MHz	25 dBm EIRP
7	Norway	5725 - 5795 MHz 5815 - 5850 MHz (*1)	Yes	30 MHz	53 dBm EIRP
				15 MHz	51 dBm EIRP
				10 MHz	50 dBm EIRP
				5 MHz	47 dBm EIRP
8	Full Power	5725 - 5850 MHz		5, 10, 15, 30 MHz	25 dBm
10	Spain	5725 - 5795 MHz	Yes	30 MHz	35 dBm EIRP
				15 MHz	33 dBm EIRP

Region code	License / regulation	Frequencies	DFS	Channel bandwidth	Max power
		5815 - 5850 MHz (*1)		10 MHz	31 dBm EIRP
				5 MHz	28 dBm EIRP
11	Korea	5725 - 5825 MHz		30 MHz	43 dBm EIRP
				15 MHz	41 dBm EIRP
				10 MHz	40 dBm EIRP
				5 MHz	37 dBm EIRP
19	India (*3)	5825 - 5850 MHz		10, 15 MHz	36 dBm EIRP
				5 MHz	33 dBm EIRP
20	Thailand	5725 - 5850 MHz		5, 10, 15, 30 MHz	30 dBm EIRP
22	Germany	5755 - 5850 MHz	Yes	30 MHz	35 dBm EIRP
				15 MHz	33 dBm EIRP
				10 MHz	31 dBm EIRP
				5 MHz	28 dBm EIRP
24	Bahrain	5725 - 5850 MHz	Yes	30 MHz	32 dBm EIRP
				15 MHz	29 dBm EIRP
				10 MHz	28 dBm EIRP
				5 MHz	25 dBm EIRP
25	ETSI	5725 - 5850 MHz	Yes	30 MHz	35 dBm EIRP
				15 MHz	33 dBm EIRP
				10 MHz	31 dBm EIRP
				5 MHz	28 dBm EIRP
27	Denmark, Switzerland, Liechtenstein	5725 - 5795 5815 - 5850 MHz (*1)	Yes	30 MHz	35 dBm EIRP
				15 MHz	33 dBm EIRP
				10 MHz	31 dBm EIRP
				5 MHz	28 dBm EIRP
28	Greece	5725 - 5795 MHz	Yes	30 MHz	35 dBm EIRP
				15 MHz	33 dBm EIRP

Region code	License / regulation	Frequencies	DFS	Channel bandwidth	Max power
				10 MHz	31 dBm EIRP
				5 MHz	28 dBm EIRP
29	Portugal, Iceland, Serbia	5725 - 5850 MHz	Yes	30 MHz	35 dBm EIRP
				15 MHz	33 dBm EIRP
				10 MHz	31 dBm EIRP
				5 MHz	28 dBm EIRP

(*1) Region codes 4, 7, 10 and 27: the 5795 MHz to 5815 MHz band is assigned for Road Transport and Traffic Telematics (RTTT).

(*2) Region code 1: reduced TX power at band edges.

(*3) Region code 19: The PTP 59600 can be deployed instead of the PTP 58600, as it meets the requirements of the 5.8 GHz license for India.

Table 89 Licenses and region codes for 5.9 GHz

Region code	License / regulation	Frequencies	DFS	Channel bandwidth	Max power
15	Unrestricted	5825 - 5925 MHz		5, 10, 15, 30 MHz	25 dBm
16	Russia	5825 - 5925 MHz		5, 10, 15, 30 MHz	25 dBm
17	India	5875 - 5925 MHz		10, 15, 30 MHz	36 dBm EIRP
				5 MHz	33 dBm EIRP
19	India (*1)	5825 - 5875 MHz		10, 15, 30 MHz	36 dBm EIRP
				5 MHz	33 dBm EIRP

(*1) Region code 19: The PTP 58600 can be deployed instead of the PTP 59600, as it meets the requirements of the 5.8 GHz license for India.

Default and alternative region codes

Table 90 lists the default and alternative region codes that are provided when PTP 600 products are shipped. The terms ‘default’ and ‘alternative’ are defined as follows:

- The product is shipped with a factory installed license key for the **default region code**.
- The product is shipped with a document that contains a license key for the **alternative region code**.

If the link is to be installed in any permitted region other than the default or alternative, then obtain a new license key from the reseller or distributor.

Table 90 Default and alternative region codes for PTP 600 variants

Variant	Default region code and regulation	Alternative region code and regulation
PTP 25600	16 - FCC USA	18 - Taiwan
PTP 45600	23 - US Federal	none
PTP 48600	15 - US Federal Extended	23 - US Federal
PTP 49600	14 - USA/Canada Public Safety	18 - Hong Kong Public Safety
PTP 54600 FCC/IC	13 - Canada	12 - FCC USA
PTP 54600 ETSI/RoW	26 - ETSI	13 - Australia
PTP 54600 OOBM	12 - Mexico	none
PTP 58600 FCC/IC	1 - FCC USA, Canada, Taiwan, Brazil	none
PTP 58600 ETSI/RoW	25 - ETSI	4 - UK
PTP 58600 OOBM	3 - Mexico	none
PTP 59600	16 - Russia	17 - India

Notifications

This section contains notifications of compliance with the radio regulations that are in force in various regions.

PTP 25600 regulatory compliance

The PTP 25600 complies with the regulations that are in force in the USA. The relevant notifications are specified in this section.

U.S. Federal Communication Commission (FCC) notification

This device complies with Part 27 of the US FCC Rules and Regulations. Use of this product is limited to operators holding Licenses for the specific operating channels.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15E of the US FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio-frequency energy and, if not installed and used in accordance with these instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to correct the interference by one or more of the following measures:

- Increase the separation between the affected equipment and the unit;
- Connect the affected equipment to a power outlet on a different circuit from that which the receiver is connected to;
- Consult the dealer and/or experienced radio/TV technician for help.

FCC IDs Certification Numbers are reproduced on the product label (Figure 73).

Figure 73 FCC certifications on 2.5 GHz product label

Where necessary, the end user is responsible for obtaining any National licenses required to operate this product and these must be obtained before using the product in any particular country. Contact the appropriate national administrations for details on the conditions of use for the bands in question and any exceptions that might apply.

PTP 49600 regulatory compliance

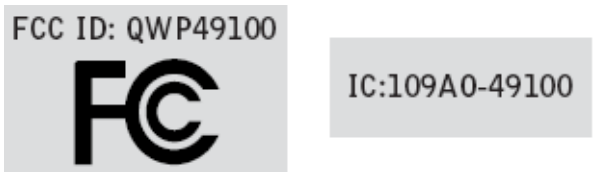
The PTP 49600 complies with the regulations that are in force in the USA and Canada. The relevant notifications are specified in this section.

PTP 49600 FCC and IC notification

The system has been approved under FCC Part 90 and Industry Canada RSS-111 for Public Safety Agency usage. The installer or operator is responsible for obtaining the appropriate site licenses before installing or using the system.

FCC IDs and Industry Canada Certification Numbers are reproduced on the product label (Figure 74).

Figure 74 FCC and IC certifications on 4.9 GHz product label



PTP 54600 regulatory compliance

The PTP 54600 complies with the regulations that are in force in the USA, Canada and Europe. The relevant notifications are specified in this section.

PTP 54600 FCC and IC notification

U.S. Federal Communication Commission (FCC) and Industry Canada (IC) Notification.

This device complies with part 15.407 of the US FCC Rules and Regulations and with RSS-210 Issue 7 of Industry Canada. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation. In Canada, users should be cautioned to take note that high power radars are allocated as primary users (meaning they have priority) of 5250 – 5350 MHz and 5470 – 5725 MHz and these radars could cause interference and/or damage to license-exempt local area networks (LELAN).

For the connectorized version of the product and in order to reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that permitted by the regulations. The transmitted power must be reduced to achieve this requirement.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the US FCC Rules and with RSS-210 of Industry Canada. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio-frequency energy and, if not installed and used in accordance with these instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to correct the interference by one or more of the following measures:

- Increase the separation between the affected equipment and the unit;
- Connect the affected equipment to a power outlet on a different circuit from that which the receiver is connected to;
- Consult the dealer and/or experienced radio/TV technician for help.

FCC IDs and Industry Canada Certification Numbers are reproduced on the product label (Figure 75).

Figure 75 FCC and IC certifications on 5.4 GHz product label

This device complies with Part 15 of the FCC Rules.
Operation is subject to the following two conditions:
1 This device may not cause harmful interference, and
2 This device must accept any interference received, including interference that may cause undesired operation.
FCC ID: QWP54100
IC:109AO-54100

Where necessary, the end user is responsible for obtaining any National licenses required to operate this product and these must be obtained before using the product in any particular country. Contact the appropriate national administrations for details on the conditions of use for the bands in question and any exceptions that might apply.

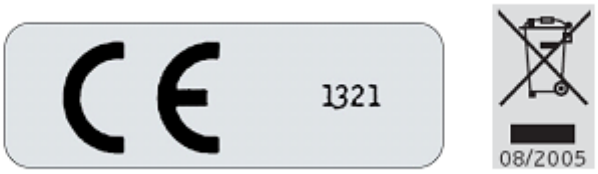
PTP 54600 European Union notification

The PTP 54600 product is a two-way radio transceiver suitable for use in Broadband Wireless Access System (WAS), Radio Local Area Network (RLAN), or Fixed Wireless Access (FWA) systems. It is a Class 1 device and uses operating frequencies that are harmonized throughout the EU member states. The operator is responsible for obtaining any national licenses required to operate this product and these must be obtained before using the product in any particular country.

Hereby, Cambium declares that the PTP 54600 product complies with the essential requirements and other relevant provisions of Directive 1999/5/EC. The declaration of conformity may be consulted at the support website (see Contacting Cambium Networks on page 2).

The European R&TTE directive 1999/5/EC Certification Number is reproduced on the product label (Figure 76).

Figure 76 European Union certification on 5.4 GHz product label



PTP 58600 regulatory compliance

This system has achieved Type Approval in various countries around the world. This means that the system has been tested against various local technical regulations and found to comply. The frequency band in which the system operates is 'license exempt' and the system is allowed to be used provided it does not cause interference. The licensing authority does not guaranteed protection against interference from other products and installations.

For the connectorized version of the product and in order to reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the Effective Isotropically Radiated Power (EIRP) is not more than that permitted for successful communication.

U.S. Federal Communication Commission (FCC)

This device complies with part 15 of the US FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the US FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio-frequency energy and, if not installed and used in accordance with these instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to correct the interference by one or more of the following measures:

- Increase the separation between the affected equipment and the unit;
- Connect the affected equipment to a power outlet on a different circuit from that which the receiver is connected to;
- Consult the dealer and/or experienced radio/TV technician for help.

Industry Canada (IC)

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B conforme á la norme NMB-003 du Canada.

RSS-GEN issue 3 (7.1.3) Licence-Exempt Radio Apparatus:

> This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.
>
> *Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.*

In Canada, high power radars are allocated as primary users (meaning they have priority) of the 5650 – 5850 MHz spectrum. These radars could cause interference or damage to license-exempt local area network (LE-LAN) devices.

Product labels

FCC IDs and Industry Canada Certification Numbers are reproduced on the product label (Figure 77).

Figure 77 FCC and IC certifications on 5.8 GHz product label

This device complies with Part 15 of the FCC Rules.
Operation is subject to the following two conditions:
1 This device may not cause harmful interference, and
2 This device must accept any interference received, including interference that may cause undesired operation.
FCC ID: QWP58100
IC:109AO-58100

Where necessary, the end user is responsible for obtaining any National licenses required to operate this product and these must be obtained before using the product in any particular country. Contact the appropriate national administrations for details on the conditions of use for the bands in question and any exceptions that might apply.

PTP 58600 European Union notification

The PTP 58600 is a Class 2 device as it operates on frequencies that are not harmonized across the EU. Currently the product may only be operated in the UK, Eire (IRL), Germany, Norway and Denmark. However, the regulatory situation in Europe is changing and the radio spectrum may become available in other countries in future. See www.ero.dk for further information. The operator is responsible for obtaining any national licenses required to operate this product and these must be obtained before using the product in any particular country.

⚠ CAUTION

This equipment operates as a secondary application, so it has no rights against harmful interference, even if generated by similar equipment, and must not cause harmful interference on systems operating as primary applications.

Hereby, Cambium declares that the PTP 58600 product complies with the essential requirements and other relevant provisions of Directive 1999/5/EC. The declaration of conformity may be consulted at the support website (see Contacting Cambium Networks on page 2).

The European R&TTE directive 1999/5/EC Certification Number is reproduced on the product label (Figure 78).

Figure 78 European Union certification on 5.8 GHz product label

PTP 58600 operation in the UK

The PTP 58600 connectorized product has been notified for operation in the UK, and when operated in accordance with instructions for use it is compliant with UK Interface Requirement IR2007. For UK use, installations must conform to the requirements of IR2007 in terms of EIRP spectral density against elevation profile above the local horizon in order to protect Fixed Satellite Services. The frequency range 5795-5815 MHz is assigned to Road Transport & Traffic Telematics (RTTT) in the U.K. and shall not be used by FWA systems in order to protect RTTT devices. UK Interface Requirement IR2007 specifies that radiolocation services shall be protected by a Dynamic Frequency Selection (DFS) mechanism to prevent co-channel operation in the presence of radar signals.

PTP 59600 regulatory compliance

Russia

This system has been tested for type approval in Russia of fixed link equipment under the heading of BPD TZS 12.

Сертификат соответствия	Срок действия
ОС-1-РД-0241	с 28 октября 2008 г.

Thailand notification

เครื่องโทรคมนาคมและอุปกรณ์นี
มีความสอดคล้องตามข้อกำหนดของ กทช.

This telecommunication equipment conforms to the requirements of the National Telecommunications Commission.

Data throughput tables

This section contains tables and graphs to support calculation of the data rate capacity that can be provided by PTP 600 configurations, as follows:

- Data throughput capacity on page 4-74
- Range adjustment curves on page 4-85

The calculation procedure is described in Calculating data rate capacity on page 2-15.

Data throughput capacity

Table 91, Table 92, Table 93, Table 94 and Table 95 show the data throughput rates (Mbits/s) that are achieved when two PTP 600 Full ODUs are linked and the link distance (range) is 0 km. Use the curves in Range adjustment curves on page 4-85 to adjust these figures to allow for link range.

> **NOTE**
> When using these tables, be aware of the factors that affect data throughput, as listed below.

Data throughput capacity is restricted by the following factors:

- PTP 600 Lite data rates are half the PTP 600 Full rates given in this section.
- Modulation Mode “256QAM 0.81 dual” is not available in all product variants and channel bandwidths.
- Throughput for Link Symmetry 2:1 is the same as that for 1:2, but the Tx and Rx data rates are swapped.
- The data rates for Adaptive symmetry apply to the most asymmetric case where the link has significant offered traffic in one direction only. The data rates for Adaptive symmetry with bidirectional offered traffic are the same as those for Link Symmetry = 1:1 with Link Optimization = IP.

Table 91 Throughput for PTP 600 Full, link symmetry 1:1, link optimization IP

Modulation Mode	30 MHz			20 MHz			15 MHz		
	Tx	Rx	Both	Tx	Rx	Both	Tx	Rx	Both
256QAM 0.81 dual	150.01	150.01	300.02	100.06	100.06	200.12	75.37	75.37	150.74
64QAM 0.92 dual	126.39	126.39	252.78	84.30	84.30	168.61	63.50	63.50	127.01
64QAM 0.75 dual	103.28	103.28	206.57	68.89	68.89	137.78	51.89	51.89	103.79
16QAM 0.87 dual	80.35	80.35	160.70	53.60	53.60	107.19	40.37	40.37	80.74
16QAM 0.63 dual	57.76	57.76	115.52	38.53	38.53	77.06	29.02	29.02	58.04
256QAM 0.81 single	75.00	75.00	150.01	50.03	50.03	100.06	37.69	37.69	75.37
64QAM 0.92 single	63.19	63.19	126.39	42.15	42.15	84.30	31.75	31.75	63.50
64QAM 0.75 single	51.64	51.64	103.28	34.45	34.45	68.89	25.95	25.95	51.89
16QAM 0.87 single	40.17	40.17	80.35	26.80	26.80	53.59	20.18	20.18	40.37
16QAM 0.63 single	28.88	28.88	57.76	19.26	19.26	38.53	14.51	14.51	29.02
QPSK 0.87 single	20.09	20.09	40.17	13.40	13.40	26.79	10.09	10.09	20.18
QPSK 0.63 single	14.44	14.44	28.88	9.63	9.63	19.26	7.25	7.25	14.51
BPSK 0.63 single	7.22	7.22	14.44	4.81	4.81	9.63	3.63	3.63	7.25

At zero range. All rates are in Mbit/s.

Table 91 Throughput for PTP 600 Full, link symmetry 1:1, link optimization IP (continued)

Modulation Mode	10 MHz			5 MHz		
	Tx	Rx	Both	Tx	Rx	Both
256QAM 0.81 dual	50.11	50.11	100.21	24.22	24.22	48.43
64QAM 0.92 dual	42.22	42.22	84.43	20.40	20.40	40.80
64QAM 0.75 dual	34.50	34.50	69.00	16.67	16.67	33.34
16QAM 0.87 dual	26.84	26.84	53.68	12.97	12.97	25.94
16QAM 0.63 dual	19.29	19.29	38.59	9.32	9.32	18.65
256QAM 0.81 single	25.05	25.05	50.11	12.11	12.11	24.21
64QAM 0.92 single	21.11	21.11	42.21	10.20	10.20	20.40
64QAM 0.75 single	17.25	17.25	34.50	8.34	8.34	16.67
16QAM 0.87 single	13.42	13.42	26.84	6.48	6.48	12.97
16QAM 0.63 single	9.65	9.65	19.29	4.66	4.66	9.32
QPSK 0.87 single	6.71	6.71	13.42	3.24	3.24	6.48
QPSK 0.63 single	4.82	4.82	9.64	2.33	2.33	4.66
BPSK 0.63 single	2.41	2.41	4.82	1.16	1.16	2.33

Table 92 Throughput for PTP 600 Full, link symmetry 1:1, link optimization TDM

Modulation Mode	30 MHz			20 MHz			15 MHz		
	Tx	Rx	Both	Tx	Rx	Both	Tx	Rx	Both
256QAM 0.81 dual	140.87	140.87	281.74	96.01	96.01	192.02	72.92	72.92	145.83
64QAM 0.92 dual	118.69	118.69	237.38	80.89	80.89	161.78	61.43	61.43	122.87
64QAM 0.75 dual	96.99	96.99	193.98	66.10	66.10	132.21	50.20	50.20	100.41
16QAM 0.87 dual	75.45	75.45	150.91	51.43	51.43	102.85	39.06	39.06	78.11
16QAM 0.63 dual	54.24	54.24	108.48	36.97	36.97	73.94	28.08	28.08	56.15
256QAM 0.81 single	70.43	70.43	140.87	48.00	48.00	96.01	36.46	36.46	72.91
64QAM 0.92 single	59.34	59.34	118.69	40.44	40.44	80.89	30.72	30.72	61.43
64QAM 0.75 single	48.49	48.49	96.99	33.05	33.05	66.10	25.10	25.10	50.20
16QAM 0.87 single	37.73	37.73	75.45	25.71	25.71	51.42	19.53	19.53	39.05
16QAM 0.63 single	27.12	27.12	54.24	18.48	18.48	36.97	14.04	14.04	28.07
QPSK 0.87 single	18.86	18.86	37.72	12.85	12.85	25.71	9.76	9.76	19.52
QPSK 0.63 single	13.56	13.56	27.12	9.24	9.24	18.48	7.02	7.02	14.03
BPSK 0.63 single	6.78	6.78	13.56	4.62	4.62	9.24	3.51	3.51	7.02

At zero range. All rates are in Mbit/s.

Table 92 Throughput for PTP 600 Full, link symmetry 1:1, link optimization TDM (continued)

Modulation Mode	10 MHz			5 MHz		
	Tx	Rx	Both	Tx	Rx	Both
256QAM 0.81 dual	49.14	49.14	98.29	24.22	24.22	48.43
64QAM 0.92 dual	41.41	41.41	82.81	20.40	20.40	40.80
64QAM 0.75 dual	33.84	33.84	67.67	16.67	16.67	33.34
16QAM 0.87 dual	26.32	26.32	52.64	12.97	12.97	25.94
16QAM 0.63 dual	18.92	18.92	37.84	9.32	9.32	18.65
256QAM 0.81 single	24.57	24.57	49.14	12.11	12.11	24.21
64QAM 0.92 single	20.70	20.70	41.40	10.20	10.20	20.40
64QAM 0.75 single	16.92	16.92	33.83	8.34	8.34	16.67
16QAM 0.87 single	13.16	13.16	26.32	6.48	6.48	12.97
16QAM 0.63 single	9.46	9.46	18.92	4.66	4.66	9.32
QPSK 0.87 single	6.58	6.58	13.16	3.24	3.24	6.48
QPSK 0.63 single	4.73	4.73	9.46	2.33	2.33	4.66
BPSK 0.63 single	2.36	2.36	4.73	1.16	1.16	2.33

Table 93 Throughput for PTP 600 Full, link symmetry 2:1, link optimization = IP

Modulation Mode	30 MHz			20 MHz			15 MHz		
	Tx	Rx	Both	Tx	Rx	Both	Tx	Rx	Both
256QAM 0.81 dual	198.58	99.29	297.88	133.42	66.71	200.12	100.50	50.25	150.74
64QAM 0.92 dual	167.31	83.66	250.97	112.41	56.20	168.61	84.67	42.33	127.01
64QAM 0.75 dual	136.73	68.36	205.09	91.86	45.93	137.78	69.19	34.59	103.79
16QAM 0.87 dual	106.37	53.18	159.55	71.46	35.73	107.19	53.83	26.91	80.74
16QAM 0.63 dual	76.47	38.23	114.70	51.37	25.68	77.06	38.70	19.35	58.04
256QAM 0.81 single	99.29	49.64	148.94	66.71	33.35	100.06	50.25	25.12	75.37
64QAM 0.92 single	83.66	41.83	125.48	56.20	28.10	84.30	42.33	21.17	63.50
64QAM 0.75 single	68.36	34.18	102.54	45.93	22.96	68.89	34.59	17.30	51.89
16QAM 0.87 single	53.18	26.59	79.77	35.73	17.86	53.59	26.91	13.46	40.37
16QAM 0.63 single	38.23	19.11	57.35	25.68	12.84	38.53	19.35	9.67	29.02
QPSK 0.87 single	26.59	13.29	39.88	17.86	8.93	26.79	13.46	6.73	20.18
QPSK 0.63 single	19.11	9.56	28.67	12.84	6.42	19.26	9.67	4.84	14.51
BPSK 0.63 single	9.56	4.78	14.33	6.42	3.21	9.63	4.84	2.42	7.25

At zero range. All rates are in Mbit/s.

Table 93 Throughput for PTP 600 Full, link symmetry 2:1, link optimization = IP (continued)

Modulation Mode	10 MHz		
	Tx	Rx	Both
256QAM 0.81 dual	66.38	33.19	99.56
64QAM 0.92 dual	55.92	27.96	83.88
64QAM 0.75 dual	45.70	22.85	68.55
16QAM 0.87 dual	35.55	17.78	53.33
16QAM 0.63 dual	25.56	12.78	38.34
256QAM 0.81 single	33.19	16.59	49.78
64QAM 0.92 single	27.96	13.98	41.94
64QAM 0.75 single	22.85	11.42	34.27
16QAM 0.87 single	17.78	8.89	26.66
16QAM 0.63 single	12.78	6.39	19.17
QPSK 0.87 single	8.89	4.44	13.33
QPSK 0.63 single	6.39	3.19	9.58
BPSK 0.63 single	3.19	1.60	4.79

This combination is not available with Channel Bandwidth 5 MHz.

Table 94 Throughput for PTP 600 Full, link symmetry 2:1, link optimization = TDM

Modulation Mode	30 MHz			20 MHz			15 MHz		
	Tx	Rx	Both	Tx	Rx	Both	Tx	Rx	Both
256QAM 0.81 dual	193.06	96.53	289.58	130.66	65.33	195.99	98.83	49.42	148.25
64QAM 0.92 dual	162.66	81.33	243.98	110.08	55.04	165.13	83.27	41.63	124.90
64QAM 0.75 dual	132.92	66.46	199.38	89.96	44.98	134.94	68.05	34.02	102.07
16QAM 0.87 dual	103.41	51.70	155.11	69.98	34.99	104.98	52.94	26.47	79.40
16QAM 0.63 dual	74.34	37.17	111.50	50.31	25.15	75.46	38.05	19.03	57.08
256QAM 0.81 single	96.53	48.26	144.79	65.33	32.66	97.99	49.42	24.71	74.12
64QAM 0.92 single	81.33	40.66	121.99	55.04	27.52	82.56	41.63	20.82	62.45
64QAM 0.75 single	66.46	33.23	99.69	44.98	22.49	67.47	34.02	17.01	51.03
16QAM 0.87 single	51.70	25.85	77.55	34.99	17.49	52.49	26.47	13.23	39.70
16QAM 0.63 single	37.17	18.58	55.75	25.15	12.58	37.73	19.03	9.51	28.54
QPSK 0.87 single	25.85	12.92	38.77	17.49	8.75	26.24	13.23	6.62	19.85
QPSK 0.63 single	18.58	9.29	27.87	12.58	6.29	18.86	9.51	4.76	14.27
BPSK 0.63 single	9.29	4.64	13.93	6.29	3.14	9.43	4.76	2.38	7.13

At zero range. All rates are in Mbit/s.

Table 94 Throughput for PTP 600 Full, link symmetry 2:1, link optimization = TDM (continued)

Modulation Mode	10 MHz		
	Tx	Rx	Both
256QAM 0.81 dual	66.38	33.19	99.56
64QAM 0.92 dual	55.92	27.96	83.88
64QAM 0.75 dual	45.70	22.85	68.55
16QAM 0.87 dual	35.55	17.78	53.33
16QAM 0.63 dual	25.56	12.78	38.34
256QAM 0.81 single	33.19	16.59	49.78
64QAM 0.92 single	27.96	13.98	41.94
64QAM 0.75 single	22.85	11.42	34.27
16QAM 0.87 single	17.78	8.89	26.66
16QAM 0.63 single	12.78	6.39	19.17
QPSK 0.87 single	8.89	4.44	13.33
QPSK 0.63 single	6.39	3.19	9.58
BPSK 0.63 single	3.19	1.60	4.79

This combination is not available with Channel Bandwidth 5 MHz.

Table 95 Throughput for PTP 600 Full, link symmetry Adaptive, link optimization = IP

Modulation Mode	30 MHz			20 MHz			15 MHz		
	Tx	Rx	Both	Tx	Rx	Both	Tx	Rx	Both
256QAM 0.81 dual	236.95	59.23	296.18	148.53	49.51	198.03	112.12	37.37	149.49
64QAM 0.92 dual	199.63	49.91	249.54	125.14	41.71	166.85	94.46	31.49	125.95
64QAM 0.75 dual	163.14	40.78	203.92	102.26	34.09	136.35	77.19	25.73	102.92
16QAM 0.87 dual	126.91	31.73	158.64	79.55	26.52	106.07	60.05	20.02	80.07
16QAM 0.63 dual	91.24	22.81	114.04	57.19	19.06	76.25	43.17	14.39	57.56
256QAM 0.81 single	118.47	29.62	148.09	74.26	24.75	99.02	56.06	18.68	74.74
64QAM 0.92 single	99.82	24.95	124.77	62.57	20.85	83.42	47.23	15.74	62.97
64QAM 0.75 single	81.57	20.39	101.96	51.13	17.04	68.17	38.59	12.86	51.46
16QAM 0.87 single	63.46	15.86	79.32	39.78	13.26	53.03	30.02	10.01	40.03
16QAM 0.63 single	45.62	11.40	57.02	28.59	9.53	38.12	21.58	7.19	28.78
QPSK 0.87 single	31.73	7.93	39.66	19.89	6.63	26.51	15.01	5.00	20.01
QPSK 0.63 single	22.81	5.70	28.51	14.30	4.76	19.06	10.79	3.60	14.39
BPSK 0.63 single	11.40	2.85	14.25	7.15	2.38	9.53	5.39	1.80	7.19

At zero range. All rates are in Mbit/s.

Table 95 Throughput for PTP 600 Full, link symmetry Adaptive, link optimization = IP (continued)

Modulation Mode	10 MHz		
	Tx	Rx	Both
256QAM 0.81 dual	66.38	33.19	99.56
64QAM 0.92 dual	55.92	27.96	83.88
64QAM 0.75 dual	45.70	22.85	68.55
16QAM 0.87 dual	35.55	17.78	53.33
16QAM 0.63 dual	25.56	12.78	38.34
256QAM 0.81 single	33.19	16.59	49.78
64QAM 0.92 single	27.96	13.98	41.94
64QAM 0.75 single	22.85	11.42	34.27
16QAM 0.87 single	17.78	8.89	26.66
16QAM 0.63 single	12.78	6.39	19.17
QPSK 0.87 single	8.89	4.44	13.33
QPSK 0.63 single	6.39	3.19	9.58
BPSK 0.63 single	3.19	1.60	4.79

This combination is not available with Channel Bandwidth 5 MHz.

Range adjustment curves

Use these curves to look up the link Range and find the Throughput Factor that must be applied to adjust the 0 km data throughput rates for the required combination of Channel Bandwidth, Link Symmetry, Link Optimization, DFS and Link Range (km).

Table 96 Range adjustment characteristics

Channel width	Link sym	Link opt	DFS	Curve	See figure
30 MHz	1:1	IP		A	Figure 79
		TDM		B	Figure 80
	2:1	IP		C	Figure 81
		TDM		D	Figure 82
	Adaptive	IP		E	Figure 83
20 MHz	1:1	IP		L	Figure 88
		TDM		N	Figure 89
	2:1	IP		L	Figure 88
		TDM		O	Figure 90
	Adaptive	IP		C	Figure 81
15 MHz	1:1	IP		F	Figure 84
		TDM		G	Figure 85
	2:1	IP	None	F	Figure 84
			FCC or ETSI	C	Figure 81
		TDM	None	H	Figure 86
			FCC or ETSI	C	Figure 81
	Adaptive	IP		A	Figure 79
10 MHz	1:1	IP		F	Figure 84
		TDM		K	Figure 87
	2:1	IP		L	Figure 88
		TDM		L	Figure 88
	Adaptive	IP		L	Figure 88
5 MHz	1:1	IP, TDM		C	Figure 81

Figure 79 PTP 600 range adjustment for data rates, curve A

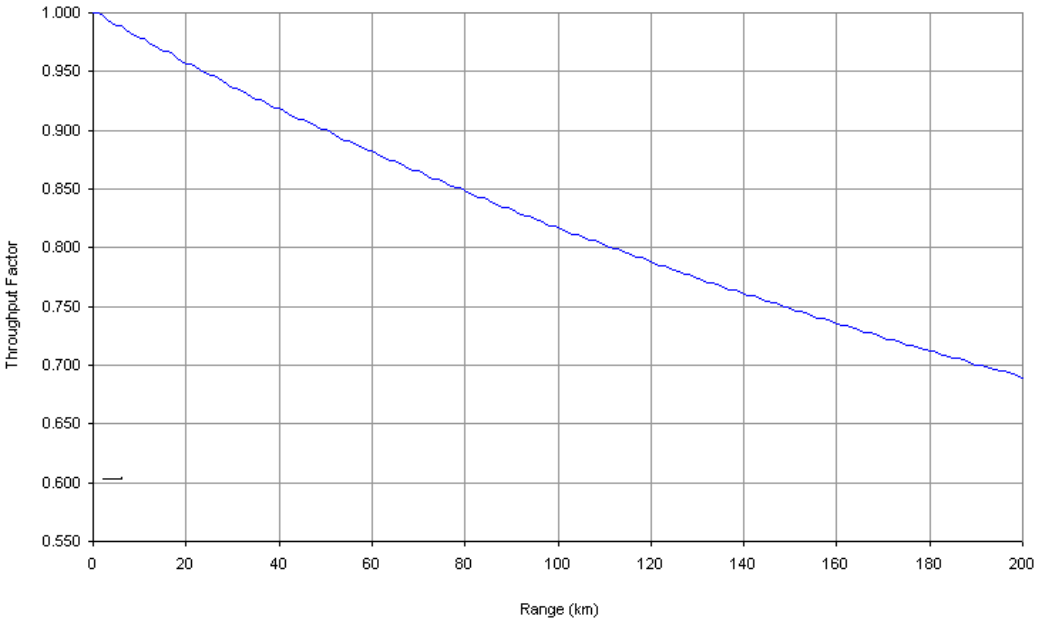


Figure 80 PTP 600 range adjustment for data rates, curve B

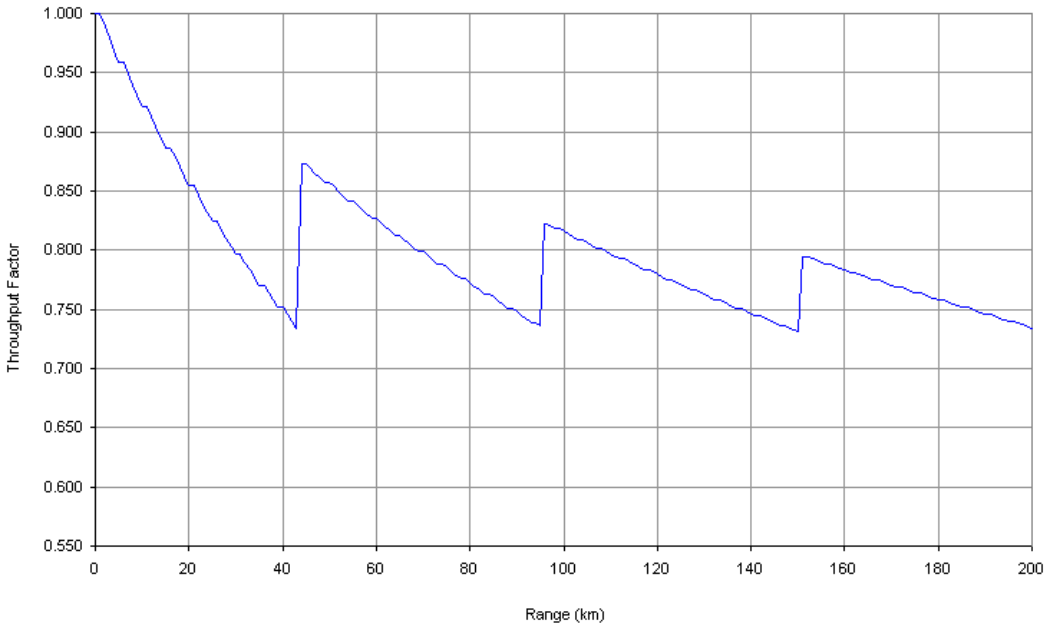


Figure 81 PTP 600 range adjustment for data rates, curve C

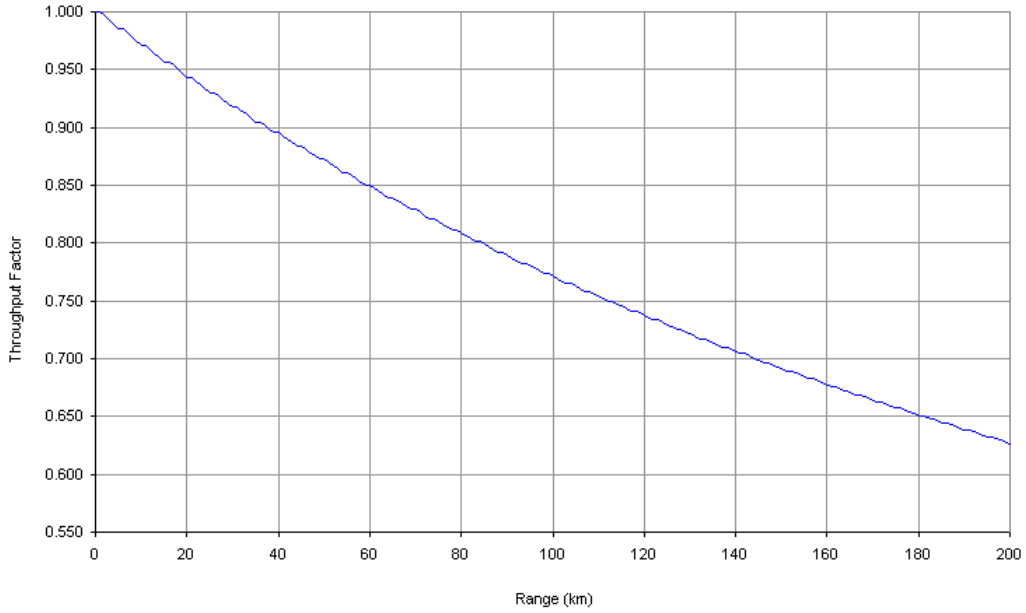


Figure 82 PTP 600 range adjustment for data rates, curve D

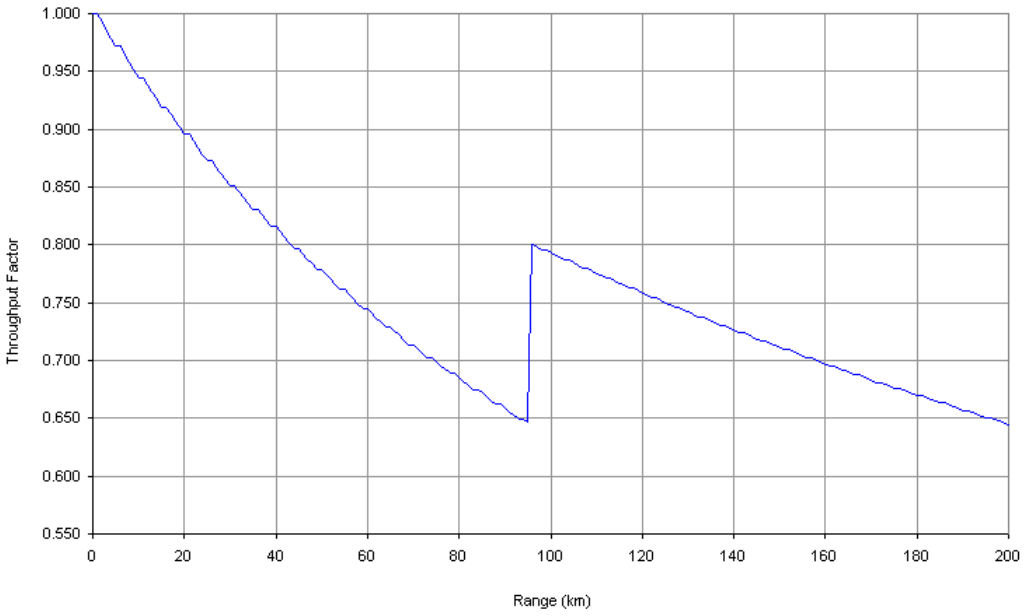


Figure 83 PTP 600 range adjustment for data rates, curve E

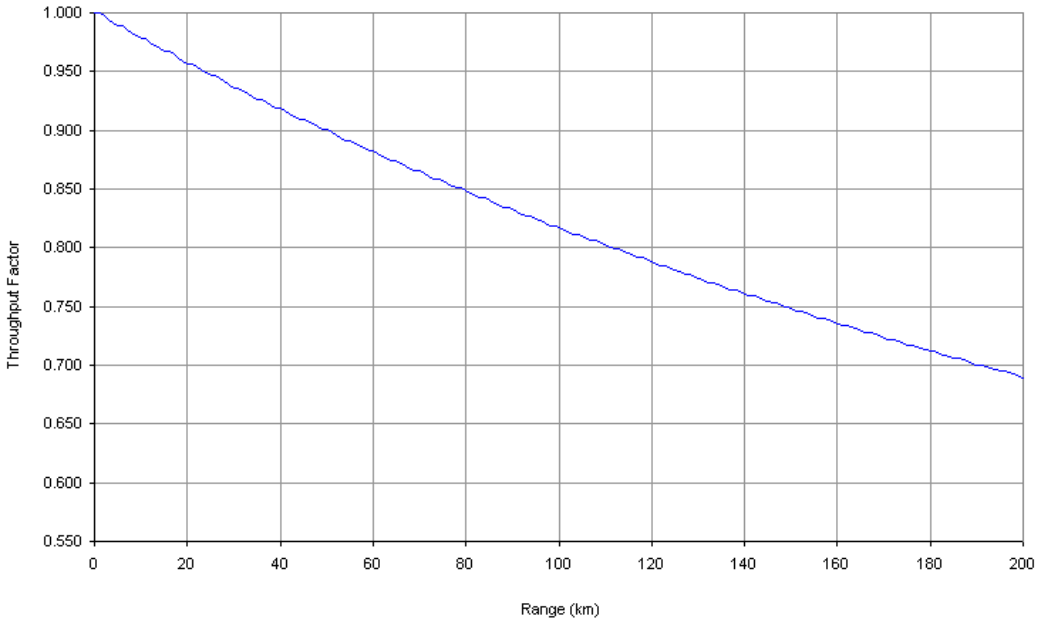


Figure 84 PTP 600 range adjustment for data rates, curve F

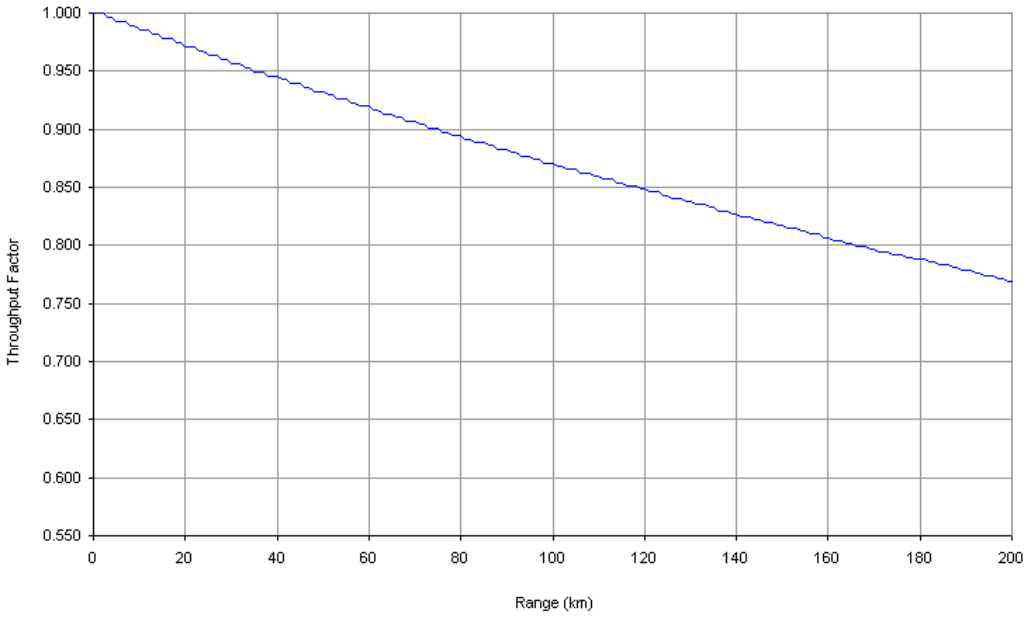


Figure 85 PTP 600 range adjustment for data rates, curve G

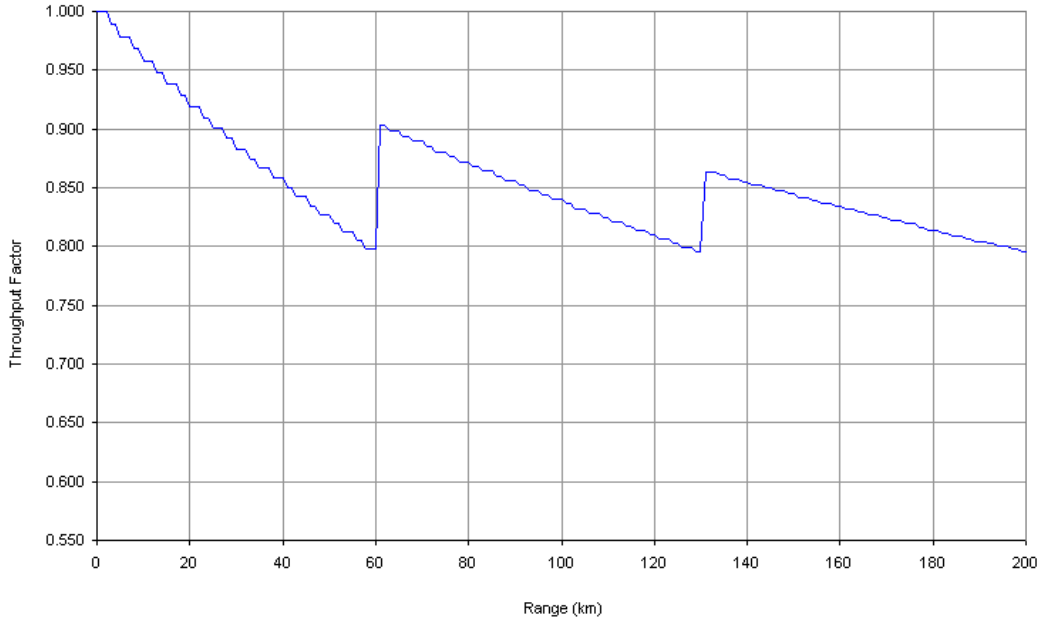


Figure 86 PTP 600 range adjustment for data rates, curve H

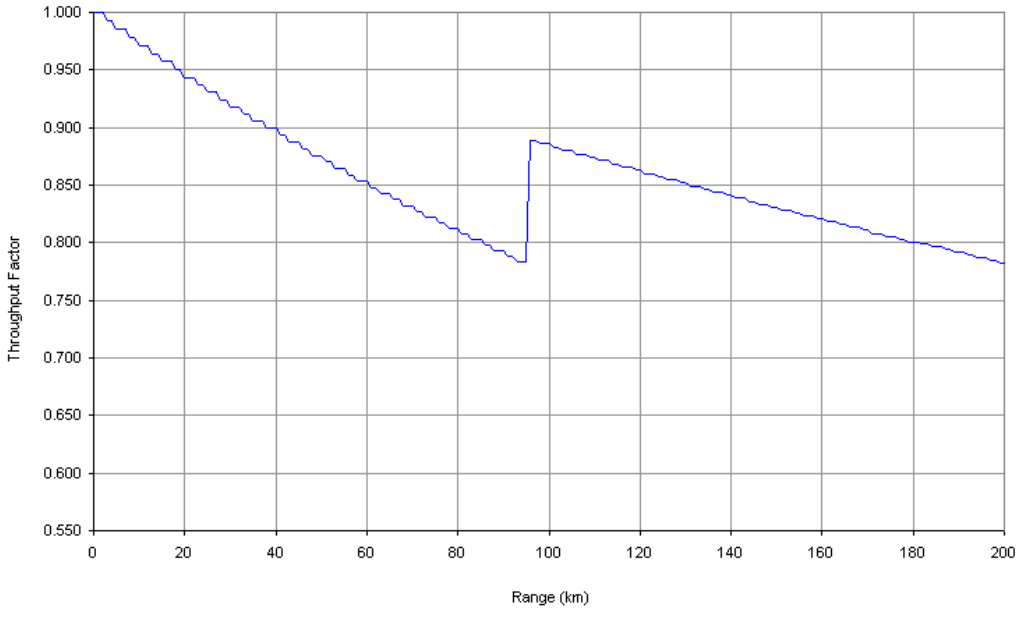


Figure 87 PTP 600 range adjustment for data rates, curve K

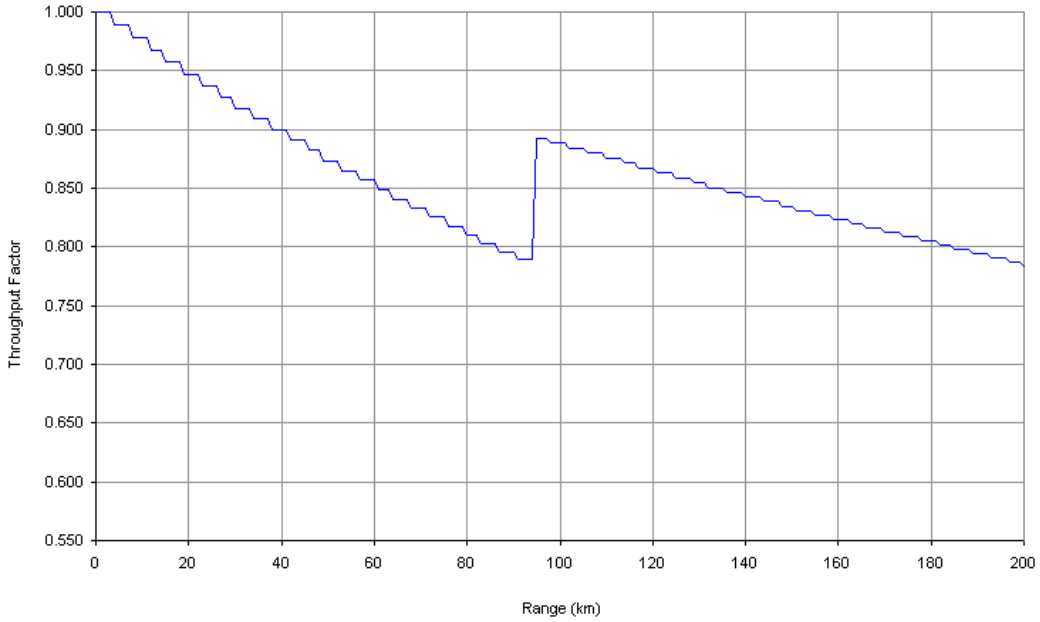


Figure 88 PTP 600 range adjustment for data rates, curve L

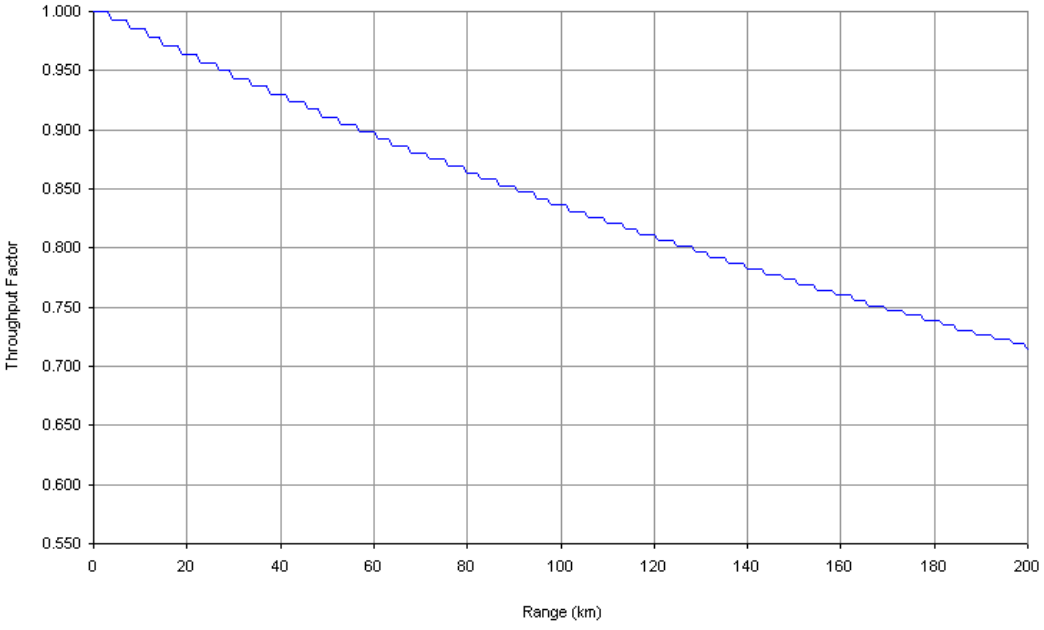


Figure 89 PTP 600 range adjustment for data rates, curve N

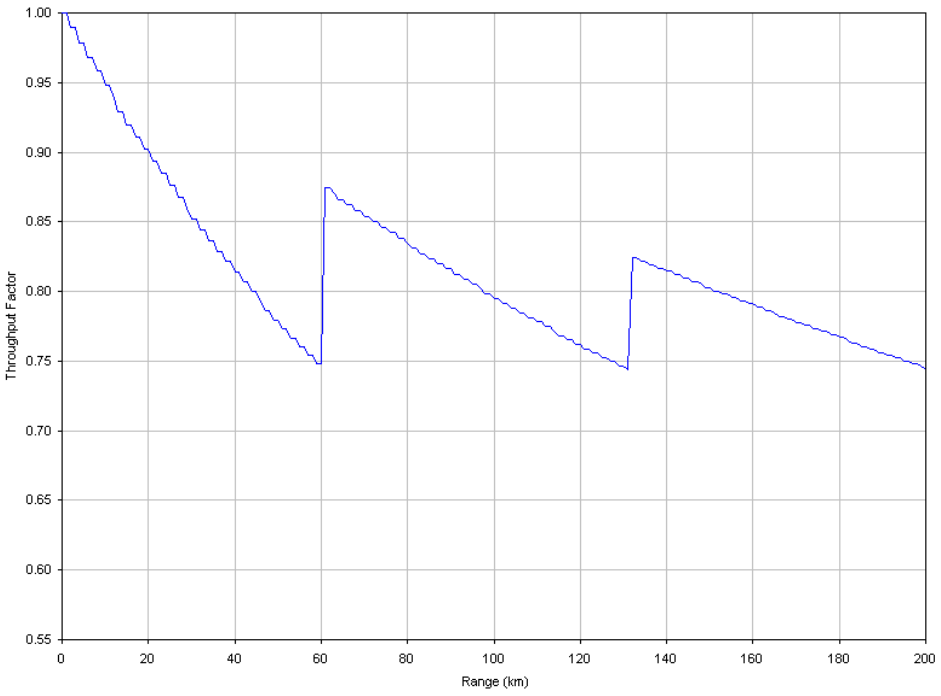
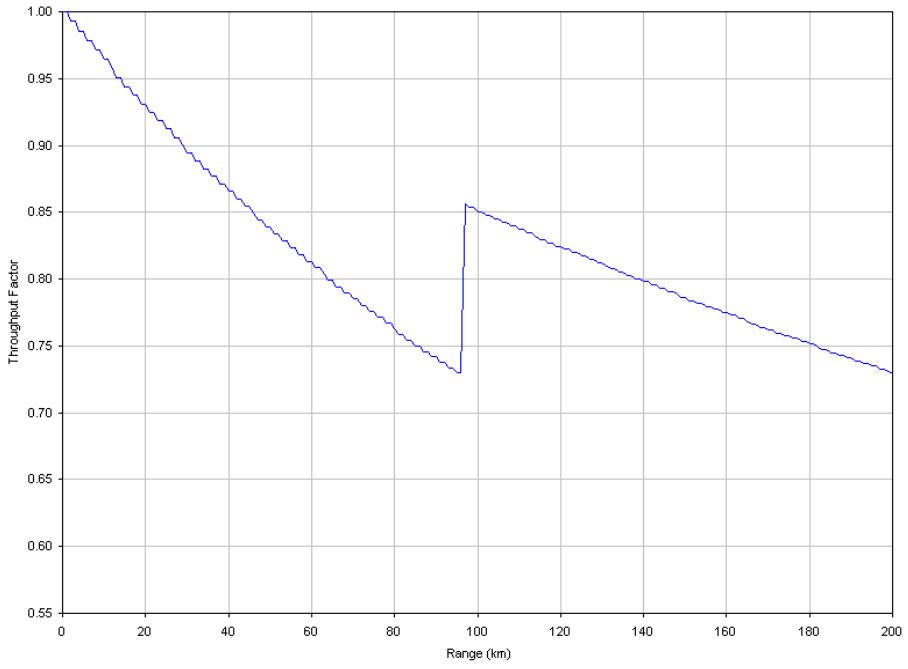


Figure 90 PTP 600 range adjustment for data rates, curve O



Chapter 5: Installation

This chapter describes how to install and test the hardware for a PTP 600 link. This chapter is arranged as follows:

- Preparing for installation on page 5-2: Describes the precautions to be observed and checks to be performed before proceeding with the installation.
- Installing the ODU and top LPU on page 5-4: Describes how to install the ODU (integrated or connectorized) and top Lightning Protection Unit (LPU) on the supporting structure.
- Installing connectorized antennas on page 5-10: Describes how to install separate antenna(s) for a connectorized ODU.
- Installing the drop cable and bottom LPU on page 5-16: Describes how to install the drop cable from the top LPU to the bottom LPU and PIDU, and to provide grounding for the installation.
- Installing the PIDU on page 5-29: Describes how to install the PIDU and connect it to the ODU and network cables.
- Installing a PTP-SYNC unit on page 5-32: Describes how to install a PTP-SYNC unit (optional).
- Installing a GPS receiver for PTP-SYNC on page 5-37: Describes how to install a GPS receiver (optional).
- Installing an E1 or T1 interface on page 5-50: Describes how to install an E1 or T1 telecommunications interface (optional).
- Installing an OOBM interface on page 5-55: Describes how to install an out-of-band management interface (optional).
- Installing a fiber interface on page 5-57: Describes how to install a fiber optic interface (optional).

Preparing for installation

This section describes the checks to be performed before proceeding with the installation.

Unit pre-configuration

It is common practice to pre-configure the units during staging before site installation by performing the following tasks from Chapter 6: Configuration and alignment:

from Task 1: Connecting to the unit on page 6-3,
to Task 10: Configuring remote access on page 6-83.

If the units are to be pre-configured during staging, the safety precautions below MUST be observed.

Safety precautions before installation

All national and local safety standards must be followed while developing a site, installing equipment, or performing maintenance.

⚠ WARNING

When installing the PTP 54600 and PTP 58600 ATEX/Hazloc product variants in hazardous locations, follow the instructions contained in the *PTP 600 Series Hazardous Location Guide* (supplied in box with the products), in addition to the instructions in this user guide.

⚠ WARNING

Ensure that personnel are not exposed to unsafe levels of RF energy. The units start to radiate as soon as they are powered up. Respect the safety standards defined in Compliance with safety standards on page 4-51, in particular the minimum separation distances.

Observe the following guidelines:

- Never work in front of the antenna when the ODU is powered.
- Always power down the PIDU when connecting and disconnecting the drop cable from either the PIDU or ODU.

Protection requirements

The installation must meet the requirements defined in Grounding and lightning protection on page 2-21.

Selecting installation options

Use the installation report to determine which installation options are required. Refer to PTP LINKPlanner on page 2-12.

Preparing personnel

In no event shall Cambium Networks be liable for any injury or damage caused during the installation of the Cambium PTP 600.

Ensure that only qualified personnel undertake the installation of a PTP 600 link.

Ensure that all safety precautions are observed.

Preparing inventory

Perform the following inventory checks:

- Check that an installation report is available and that it is based on the principles described in Chapter 2: Planning considerations.
- Check that the correct components are available, as described in Ordering components on page 2-53.
- Check the contents of all packages against their packing lists.

Preparing tools

Check that following specific tools are available, in addition to general tools:

- 13mm wrench and 22 mm wrench for use with the glands.
- RJ45 crimp tool (it must be the correct tool for the type of RJ45 being used).
- Personal Computer (PC) with 10, 100 or 1000 BaseT Ethernet.
- Either Internet Explorer 7, Internet Explorer 8, Firefox 3 or Firefox 3.5.
- Ethernet patch cables.

Installing the ODU and top LPU

Perform this task to install the ODU (integrated or connectorized) and top Lightning Protection Unit (LPU) on the supporting structure.

This task consists of the following procedures:

- Checks and safety precautions on page 5-4
- Selecting a position for the ODU (connectorized) on page 5-5
- Selecting a mounting option for the top LPU on page 5-6
- Mounting the ODU and top LPU on page 5-7
- Connecting and grounding the ODU and top LPU on page 5-8
- Installing an UltraSync GPS receiver on page 5-9

If a connectorized ODU is being installed, see also Installing connectorized antennas on page 5-10.

Checks and safety precautions

⚠ WARNING

To prevent failure of the assembly, take the following precautions:

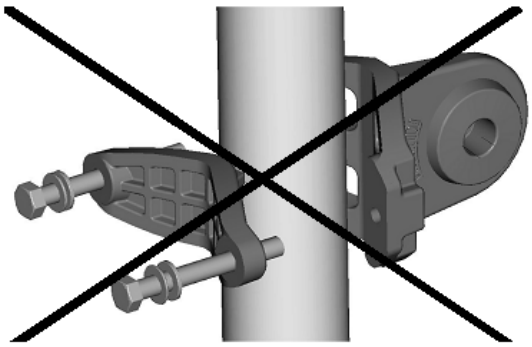
Do not remove the pre-fitted mounting bracket.

Do not mount the ODU on poles with diameter less than 50mm (2”) or greater than 75mm (3”).

Check that the integrated lifting eye and its fixing (Figure 92) are not damaged in any way and have not been exposed to a shock loading due to a fall.

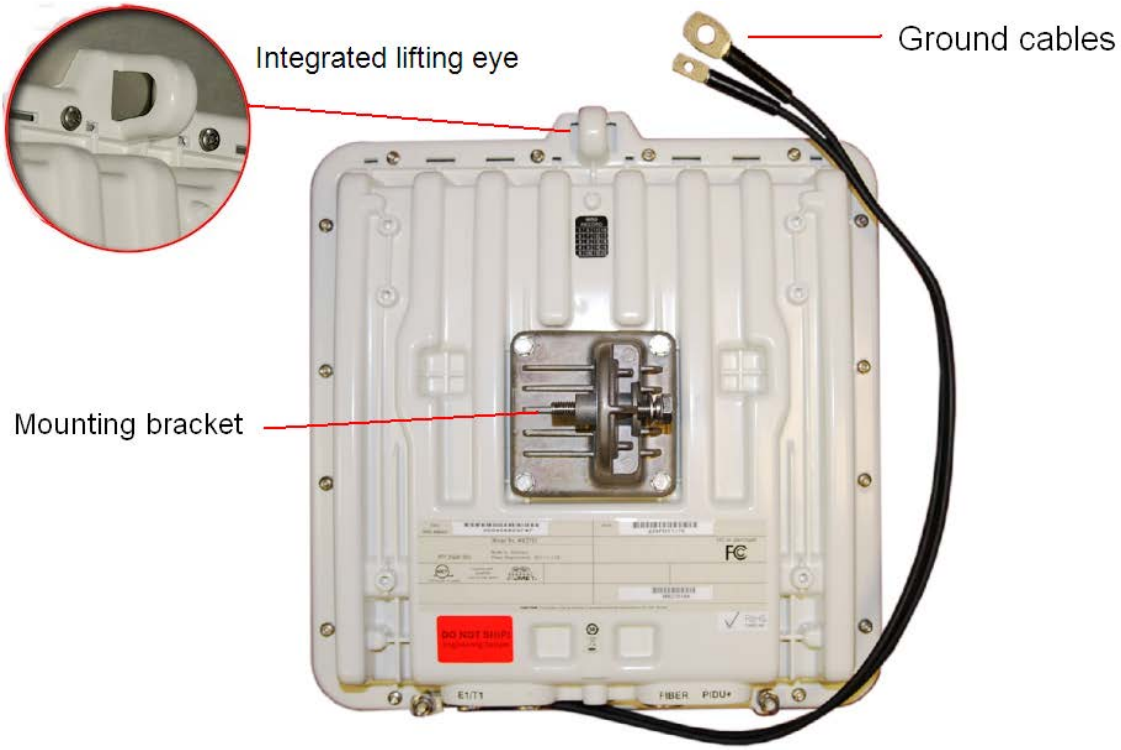
Do not reverse the rear bracket strap (Figure 91).

Figure 91 Do not reverse the rear bracket strap



Check that the ODU is pre-fitted with a mounting bracket (designed to ease installation) and with ground cables (Figure 92).

Figure 92 ODU with mounting bracket and earth bonding leads



Selecting a position for the ODU (connectorized)

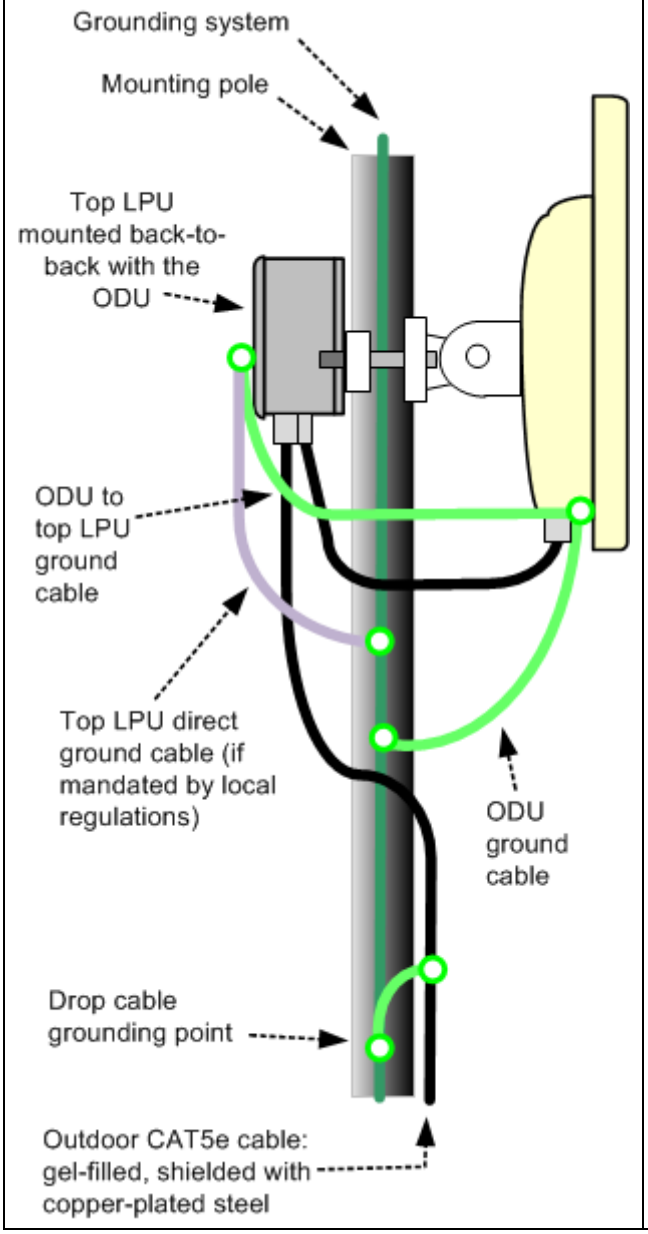
If the ODU is connectorized, select a mounting position that gives it maximum protection from the elements, but still allows easy access for connecting and weatherproofing the cables. To minimize cable losses, select a position where the antenna cable lengths can be minimized. If separate antennas are being deployed, it is not necessary to mount the ODU at the midpoint between the antennas.

Selecting a mounting option for the top LPU

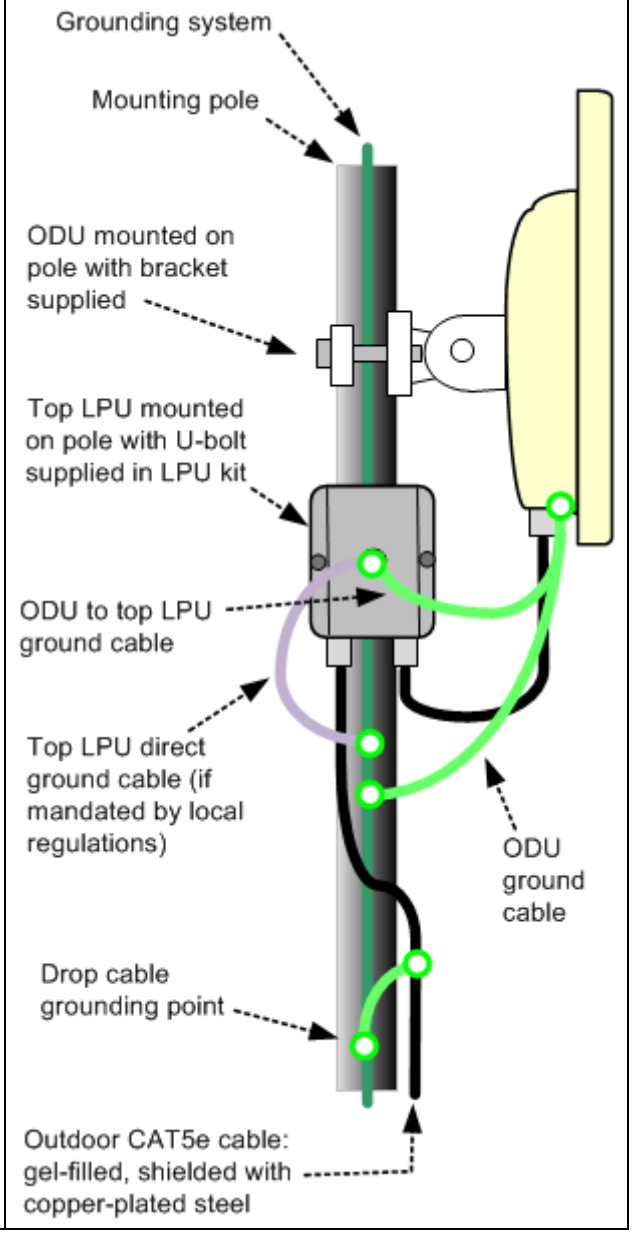
Select the most suitable mounting option for the top LPU (Figure 93).

Figure 93 Top LPU mounting options

Option 1 – LPU mounted back-to-back with the ODU, on ODU bracket (recommended):


Grounding system
Mounting pole
Top LPU mounted back-to-back with the ODU
ODU to top LPU ground cable
Top LPU direct ground cable (if mandated by local regulations)
ODU ground cable
Drop cable grounding point
Outdoor CAT5e cable: gel-filled, shielded with copper-plated steel

Option 2 – LPU mounted on pole with U-bolt supplied in LPU kit:


Grounding system
Mounting pole
ODU mounted on pole with bracket supplied
Top LPU mounted on pole with U-bolt supplied in LPU kit
ODU to top LPU ground cable
Top LPU direct ground cable (if mandated by local regulations)
ODU ground cable
Drop cable grounding point
Outdoor CAT5e cable: gel-filled, shielded with copper-plated steel

Mounting the ODU and top LPU

To mount the ODU and top LPU, proceed as follows:

1 Attach the ODU bracket strap to the pole using M8 x 40 mm or M8 x 70 mm bolts, M8 flat washers and M8 coil washers.

If LPU mounting option 1 (back-to-back) has been chosen, mount the LPU on the bracket bolts. The LPU must be vertical with cable glands facing downwards.

Tighten to ensure the assembly grips, but can be adjusted on the pole.

2 Use the integral safety loop (Figure 92) to hoist the ODU up to the bracket, observing the precautions described in Checks and safety precautions on page 5-4.

3 Offer the ODU (with pre-fitted mounting bracket) to the bracket strap and affix using the captive M8 bolt. Tighten to ensure the assembly grips, but can be adjusted on the pole.

4 Adjust the elevation and azimuth of the unit to achieve an approximate visual alignment (does not apply to connectorized ODUs). Tighten all three bracket bolts to the required torque setting of 14 Nm (11 lb ft).

> **⚠ CAUTION**
> Do not over-tighten the bolts, as this may lead to failure of the assembly.

5 If LPU mounting option 2 (U-bolt) has been chosen, mount the LPU using the U-bolt bracket. The LPU must be vertical with cable glands facing downwards.

Connecting and grounding the ODU and top LPU

To connect and ground the ODU and top LPU, proceed as follows:

1. Check that the LPU kit includes a back-to-back cable with RJ45 connectors and glands at both ends (Figure 13). This is a short length (not more than 600 mm) to connect the ODU to the top LPU.
2. Connect one end of the back-to-back cable to the PIDU port of the ODU, as described in Connecting an RJ45 and gland to a unit on page 5-21.

3. Connect the other end of the back-to-back cable to the top LPU (either port), as described in Connecting an RJ45 and gland to a unit on page 5-21.
4. Connect one ODU ground cable (small lug) to the top LPU.
5. Connect the other ODU ground cable (large lug) to the to the supporting structure grounding point, within 0.3 meters (1 ft) of the ODU bracket and on the same metal (if necessary, remove paint and apply anti-oxidant compound first).

> **⚠ CAUTION**
> Do not attach grounding cables to the ODU mounting bracket bolts, as this arrangement will not provide full protection.

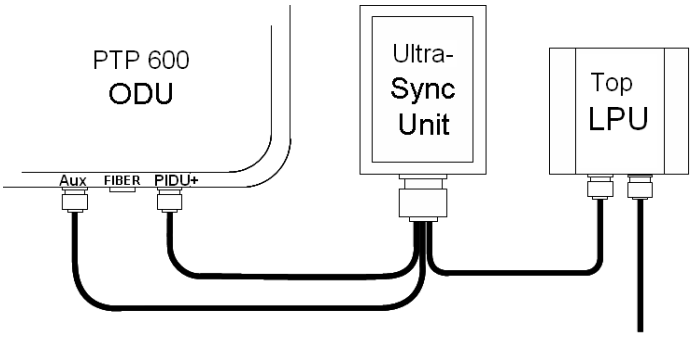
6. If local regulations mandate the independent grounding of all devices, then connect a third ground cable from the top LPU to the grounding system.
7. To prevent corrosion and possible loss of ground continuity, weatherproof the grounding points.

Installing an UltraSync GPS receiver

If the chosen TDD synchronization method requires UltraSync GPS (see Configuration options for TDD synchronization on page 2-30), then perform this task to install the UltraSync receiver.

The UltraSync GPS receiver replaces the back-to-back cable between the ODU and the top LPU (Figure 94).

Figure 94 UltraSync deployment diagram



Refer to the UltraSync user manual for details of the lengths and types of cable required to connect the UltraSync unit to the ODU and LPU.

Mount the UltraSync unit on the supporting structure. Connect the UltraSync unit to the Aux and PIDU+ ports of the ODU and to the top LPU (Figure 95).

Figure 95 UltraSync unit connections

Installing connectorized antennas

If the ODU is connectorized, perform this task to install separate antenna(s).

Preparing for connectorized installations

Before proceeding with the installation, perform the following checks:

- Check that the correct components are available, as described in Ordering components on page 2-53.
- Check that the selected antenna conforms to the applicable regulatory restrictions, as described in FCC and IC approved antennas on page 2-64 and Compliance with radio regulations on page 4-58.
- Check that the correct tools are available. The tools required for mounting the antennas are specific to the antenna chosen. Refer to the antenna manufacturer's instructions.

⚠ CAUTION

To prevent water ingress, always use crimped N-type connectors at the ODU and antenna.

Mounting and connecting antennas

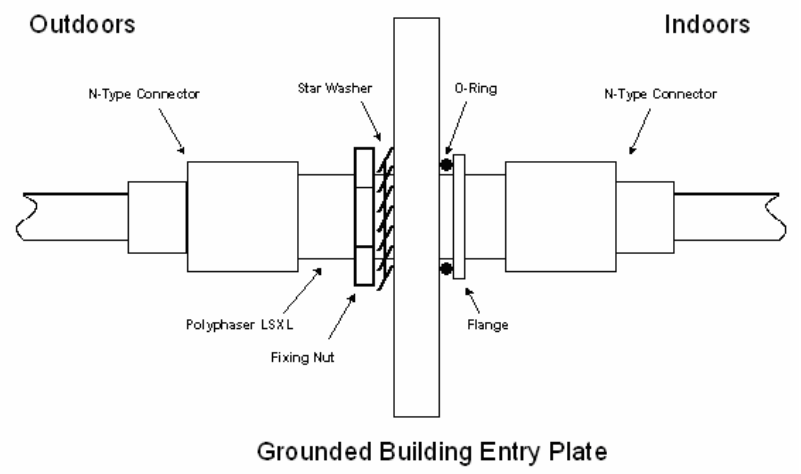
To mount and connect the antenna(s), proceed as follows:

1. Mount the antenna(s) according to manufacturer's instructions. When using separate antennas to achieve spatial diversity, mount one with Horizontal polarization and the other with Vertical polarization.
2. Connect the ODU to the antenna(s) with cables of type LMR100, LMR200, LMR300, LMR400 or LMR600. Connect the ODU 'V' interface to the vertical polarization antenna and connect the ODU 'H interface to the horizontal polarization antenna (Figure 5).

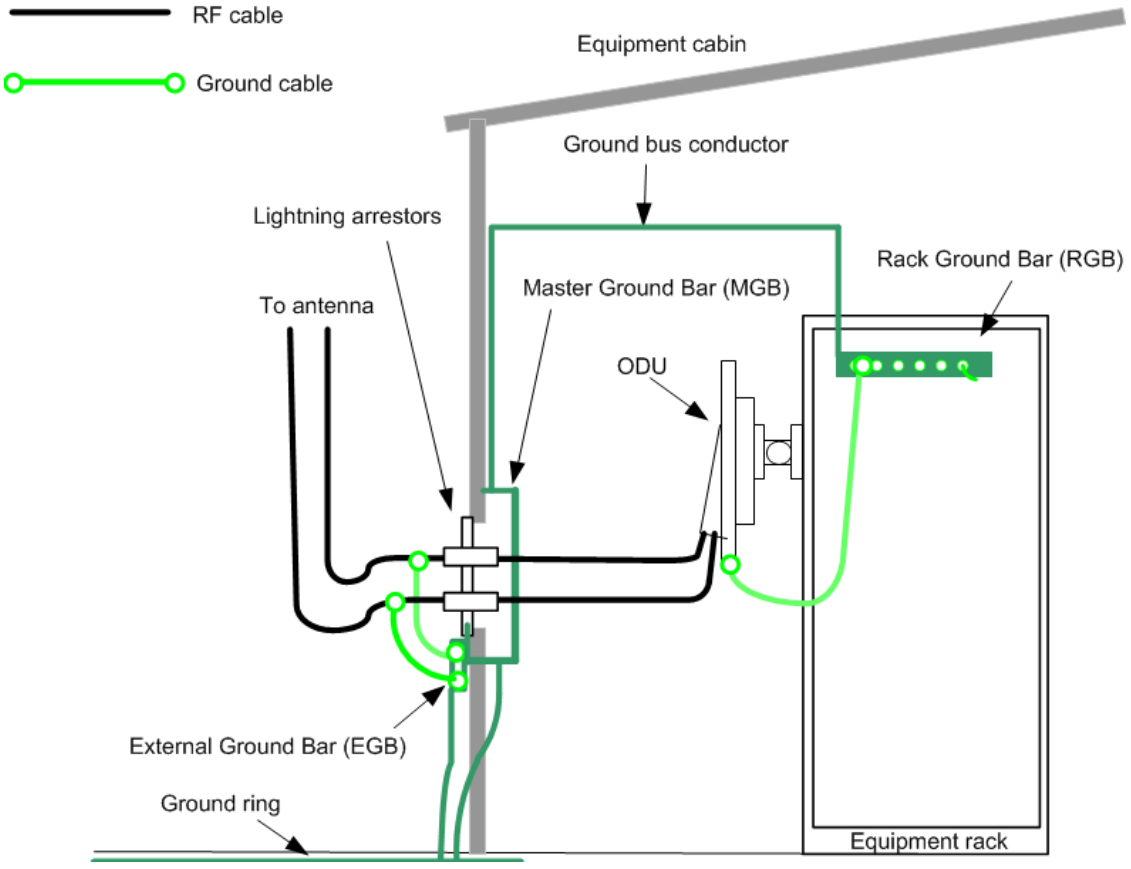
NOTE

When using separate antennas to achieve spatial diversity, the antenna cables will be disconnected from the ODU during the alignment procedure. Therefore, do not weatherproof the ODU joints until antenna alignment is complete.

3 If the ODU is to be mounted indoors, assemble the Polyphaser LSXL-ME or LSXL as shown:



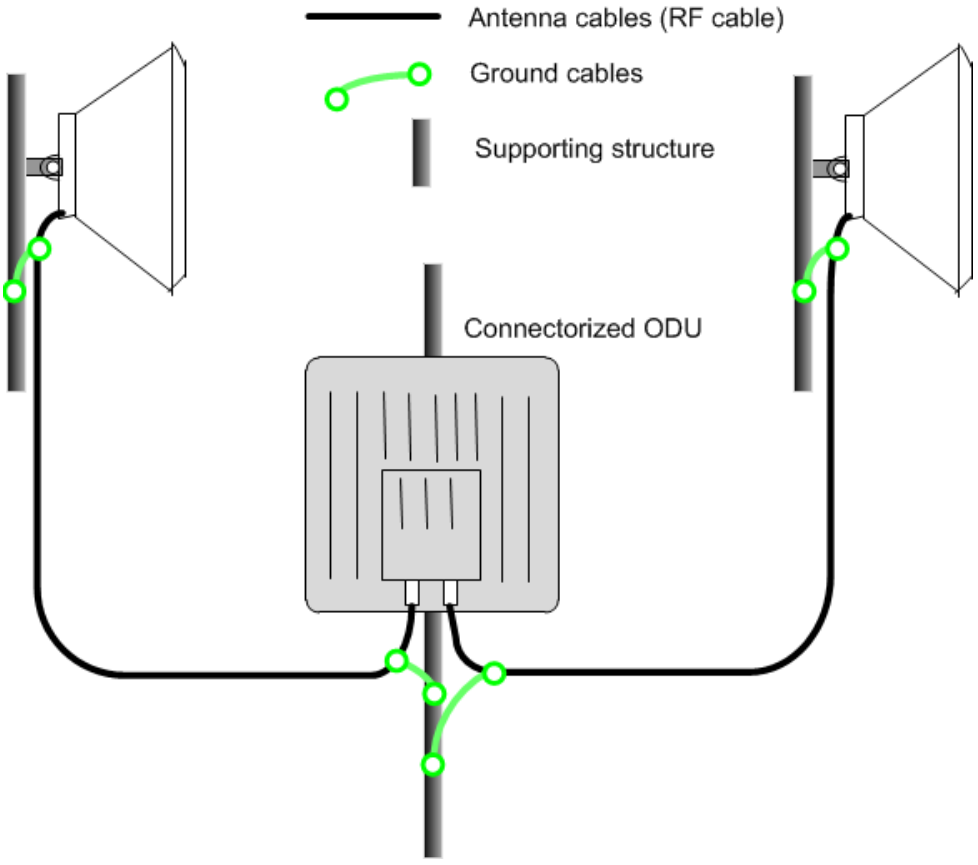
4 If the ODU is to be mounted indoors, install lightning arrestors at the building entry point. Connect the lighting arrestors to the master ground bar of the building:



5 When dressing the antenna cables, form drip loops near the lower ends. These ensure that water is not constantly channeled towards the connectors.

6 If the ODU is mounted outdoors, weatherproof the N type connectors fitted to the ODU by following the procedure Weatherproofing an N type connector on page 5-13. Weatherproof the antenna joints in the same way (unless the antenna manufacturer specifies a different method).

7 Ground the antenna cables to the supporting structure at the correct points. They should be grounded within 0.3 meters (1 foot) of the ODU and antennas using the using the Cambium grounding kit (part number 01010419001):



NOTE

A mast or tower may require additional grounding points, as specified in Protection requirements for a mast or tower installation on page 2-24.

8 Dress the antenna cables and attach them to the supporting structure using site approved methods.

CAUTION

Ensure that no undue strain is placed on the ODU or antenna connectors. Ensure that the cables do not flap in the wind, as flapping cables are prone to damage and induce unwanted vibrations in the supporting structure.

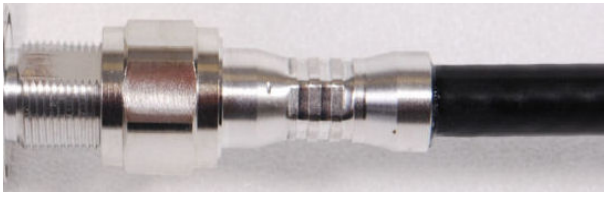
Weatherproofing an N type connector

The following procedure should be used to weatherproof the N type connectors fitted to the connectorized ODU and antenna (if recommended by the antenna manufacturer).

> **NOTE**
> N type connectors should be tightened using a torque wrench, set to 15 lb in or 1.7 Nm. If a torque wrench is not available, N type connectors may be finger tightened.

To weatherproof an N type connector, proceed as follows:

1. Ensure the connection is tight. A torque wrench should be used if available:



2. Wrap the connection with a layer of 19 mm (0.75 inch) PVC tape, starting 25 mm (1 inch) below the connector body. Overlap the tape to half-width and extend the wrapping to the body of the LPU. Avoid making creases or wrinkles:

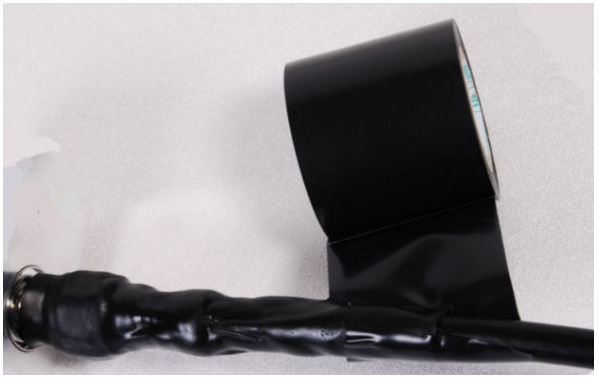
3. Smooth tape edges:

4 Cut a 125mm (5 inches) length of rubber tape (self amalgamating):

5 Expand the width of the tape by stretching it so that it will wrap completely around the connector and cable:

6 Press the tape edges together so that there are no gaps. The tape should extend 25mm (1inch) beyond the PVC tape:

7 Wrap a layer of 50 mm (2 inch) PVC tape from bottom to top, starting from 25 mm (1 inch) below the edge of the self-amalgamating tape, overlapping at half width.



8 Repeat with a further four layers of 19 mm (0.75 inch) PVC tape, always overlapping at half width. Wrap the layers in alternate directions:

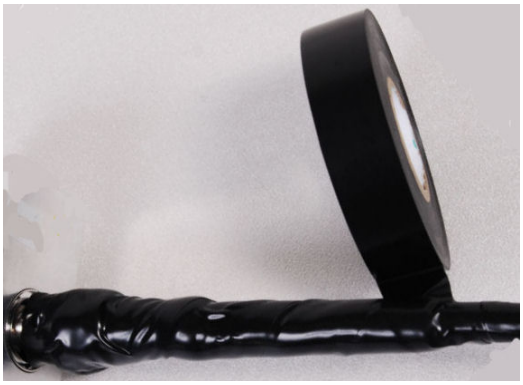
Second layer: top to bottom.

Third layer: bottom to top.

Fourth layer: top to bottom.

Fifth layer: bottom to top.

The bottom edge of each layer should be 25 mm (1 inch) below the previous layer.



9 Completed weatherproof connection:

Installing the drop cable and bottom LPU

Perform this task to install the drop cable from the top LPU to the bottom LPU and PIDU, and to provide grounding and lightning protection for the installation.

This task consists of the following procedures:

- Preparing drop cables on page 5-17.
- Assembling an RJ45 connector and gland on page 5-18.
- Installing and grounding the main drop cable on page 5-20.
- Connecting an RJ45 and gland to a unit on page 5-21.
- Disconnecting an RJ45 and gland from a unit on page 5-22.
- Making a drop cable ground point on page 5-23.
- Installing and grounding the drop cable at building entry on page 5-27.

⚠ CAUTION

The drop cable and ground cable installation must meet the requirements defined in Grounding and lightning protection on page 2-21.

⚠ CAUTION

To provide effective protection against lightning induced surges, grounding cables must be installed without drip loops and pointing down towards the ground.

⚠ CAUTION

To avoid damage to the installation, do not connect or disconnect the drop cable when power is applied to the PIDU.

Preparing drop cables

Perform this task to prepare the Cat5e cables that connect the ODU to the PIDU.

CAUTION

Always use Cat5e cable that is gel-filled and shielded with copper-plated steel. Alternative types of cable are not supported by Cambium.

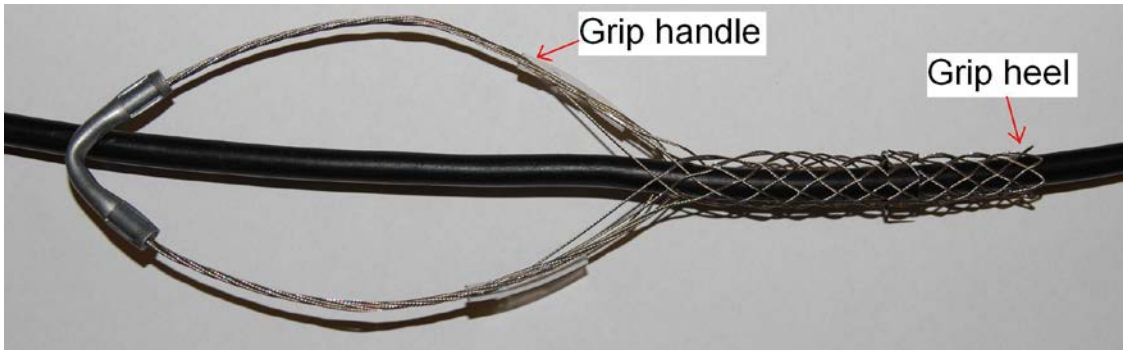
NOTE

The maximum permitted lengths of Cat5e cables are specified in Maximum cable lengths on page 2-7.

For details of supported cables and recommended connectors, refer to Ordering components on page 2-53.

'Main' drop cable: To prepare a long section of drop cable to connect the top LPU to the bottom LPU:

1. Cut off the approximate length required (allowing a bit of surplus), or leave it on the drum so that it can be unwound as the cable is hoisted.
2. Slide one or more hoisting grips onto to the top end of the main drop cable:



   To determine the number of hoisting grips required, consult the grip manufacturer.
3. Secure the hoisting grip to the cable using a special tool, as recommended by the manufacturer.
4. Fit an RJ45 connector and gland to the top end only, as described in Assembling an RJ45 connector and gland on page 5-18.

'LPU-PIDU' drop cable: To prepare a short section of drop cable to connect the bottom LPU to the PIDU (or PTP-SYNC): cut off the approximate length required (allowing a bit of surplus), then fit an RJ45 connector and gland to the LPU end only, as described in Assembling an RJ45 connector and gland on page 5-18.

Assembling an RJ45 connector and gland

Perform this task to prepare the outdoor Cat5e cable with connectors and glands.

Safety precautions

WARNING

The metal screen of the drop cable is very sharp and may cause personal injury.

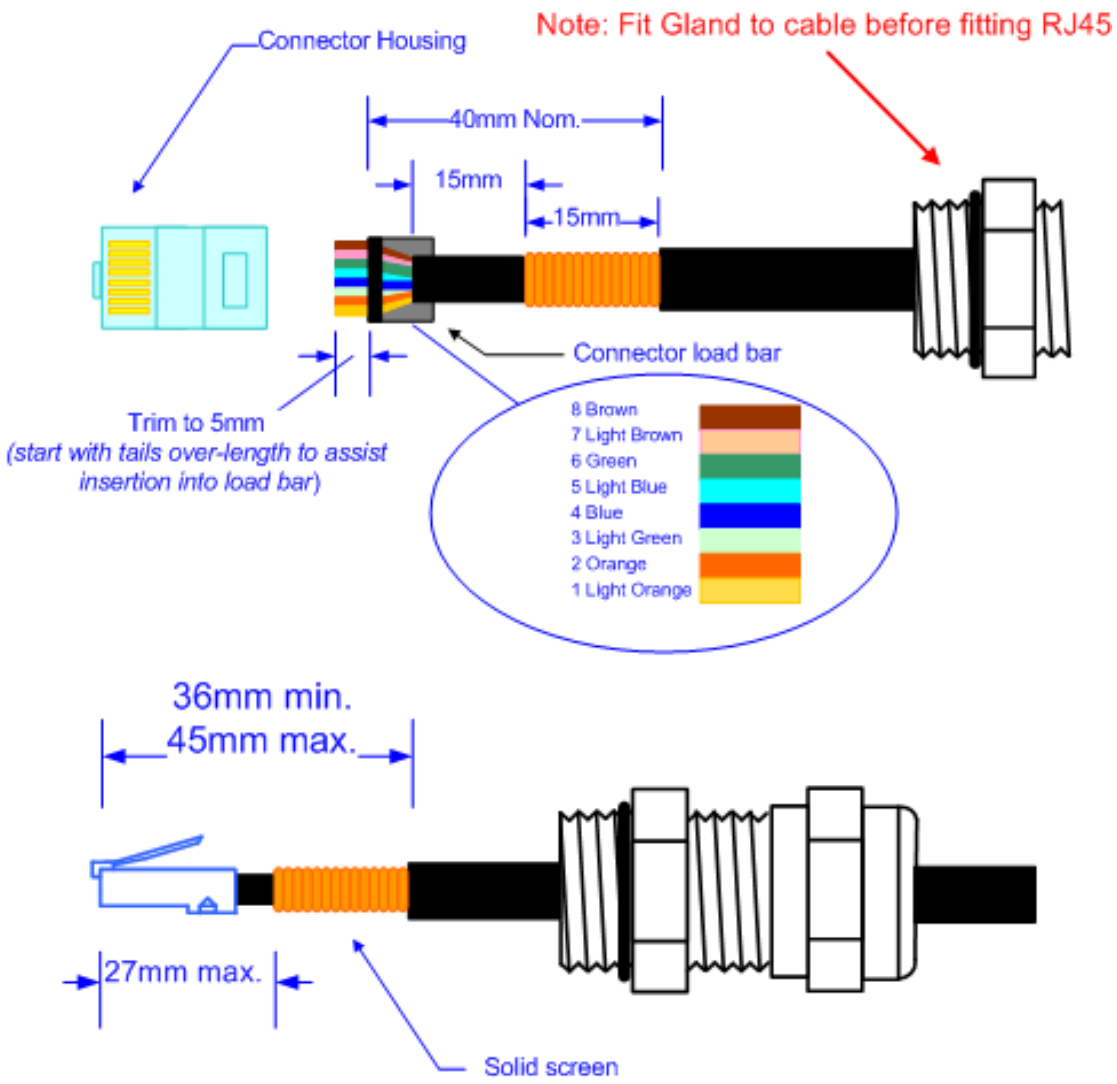
When preparing the drop cable, take the following safety precautions:

- ALWAYS wear cut resistant gloves (check the label to ensure they are cut resistant).
- ALWAYS wear protective eyewear.
- ALWAYS use a rotary blade tool to strip the cable (DO NOT use a bladed knife). To use the rotary blade tool, fit it around the outer cable sheath and rotate the cutter around the cable once or twice. The stripped outer section can then be removed.

Assembly

Assemble the drop cable as shown in Figure 96. The gland is only required for outdoor connections, that it, at the ODU or LPU. The connection to the PIDU requires the RJ45 plug but no gland.

Figure 96 Correct cable preparation for drop cable of the supported type



⚠ CAUTION

Check that the crimp tool matches the RJ45 connector being used, otherwise the cable or connector may be damaged.

⚠ CAUTION

The cable inner sheath must be located correctly under the connector housing tang. If this is not done correctly, there is no strain relief on the cable terminations.

Figure 97 shows the end of a drop cable fitted with an RJ45 plug and a gland.

Figure 97 Drop cable with RJ45 and gland

Installing and grounding the main drop cable

Perform this procedure to install the main drop cable, connect it to the top LPU, and ground it to the supporting structure.

WARNING

Follow all instructions provided by the hoisting grip manufacturer. Failure to do so may result in injury or death.

To install and ground the main drop cable, proceed as follows:

1. Hoist the main drop cable up to the top LPU using the hoisting grip and a hoist line. When the cable is in position and the grip handle is fastened to the supporting structure, remove the hoist line.
2. Connect the top end of the main drop cable to the top LPU (unused port), as described in Connecting an RJ45 and gland to a unit on page 5-21.
3. Lay the main drop cable as far as the building entry point, ensuring there is enough length to extend through the wall of the building to the bottom LPU.
4. Attach the main drop cable to the supporting structure using site approved methods.
5. Ground the drop cable to the supporting structure at the points shown in Figure 32 (mast or tower installation) or Figure 33 (wall installation), as described in Making a drop cable ground point on page 5-23.

NOTE

A mast or tower may require additional grounding points, as specified in Protection requirements for a mast or tower installation on page 2-24.

Connecting an RJ45 and gland to a unit

Perform this task to connect the drop cable to an ODU or LPU. This procedure contains illustrations of an ODU, but it applies in principle to both the ODU and the LPU.

To connect the drop cable with a gland to a unit (LPU or ODU), proceed as follows:

1 Insert the RJ45 plug into the socket in the unit, making sure that the locking tab snaps home.

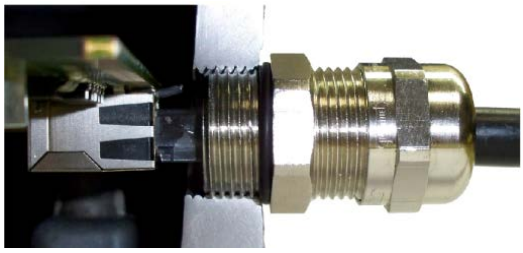
2 Support the drop cable and gently hand screw the gland body into the unit until the O ring seal is flush to the unit body.

NOTE

Do not fit the back shell prior to securing the gland body.

3 Once the gland is fully hand screwed into the unit, tighten it with a spanner to torque 10 Nm (7.4 ftlbs).

4 When the gland body has been fitted, tighten the gland back shell.



⚠ CAUTION

Do not over-tighten the gland back shell, as the internal seal and structure may be damaged. The following example shows correctly tightened and over-tightened gland back shells:

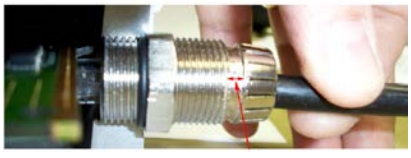
Disconnecting an RJ45 and gland from a unit

Perform this task to disconnect the drop cable from an ODU or LPU. This procedure contains illustrations of an ODU, but it applies in principle to both the ODU and the LPUs.

To disconnect the drop cable with a gland from a unit (LPU or ODU), proceed as follows:

1 Remove the gland back shell.

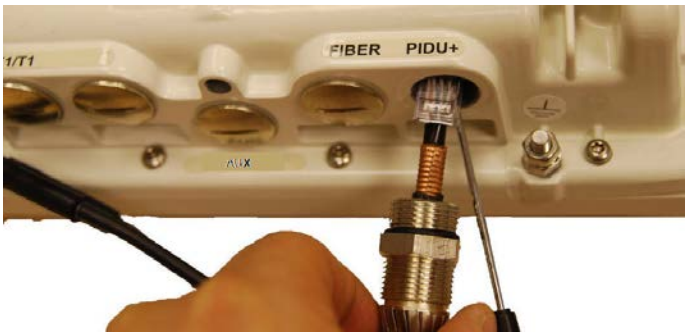
2 Wiggle the drop cable to release the tension of the gland body.



When the tension in the glad body is released, a gap opens at the point shown in red in the above photograph.

3 Unscrew the gland body.

4 Use a small screwdriver to depress the RJ45 locking cap



5 Unplug the RJ45.

Making a drop cable ground point

Perform this task to connect the screen of the drop cable to the metal of the supporting structure using a cable grounding kit. The cable grounding kit for 1/4” and 3/8” cable (Figure 12) contains the following components:

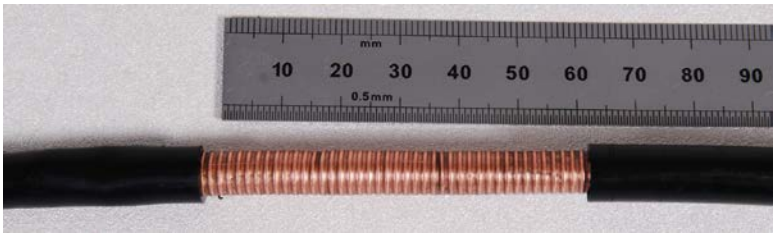
- 1 x grounding cable with grounding 2 hole lug fitted (M10)
- 1 x self Amalgamating tape
- 1 x PVC tape
- 3 x tie wraps
- 2 x bolt, washer and nut

⚠ CAUTION

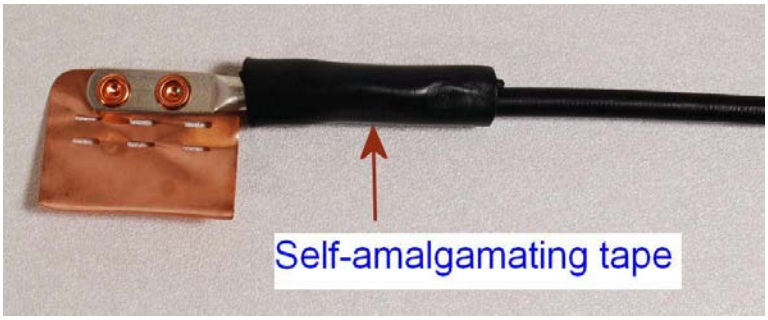
Ground cables must be installed without drip loops and pointing down towards the ground, otherwise they may not be effective.

To ground the drop cable to a metal structure using the Cambium grounding kit (part number 01010419001), proceed as follows:

1 Remove 60 mm (2.5 inches) of the drop cable outer sheath.



2 Cut 38mm (1.5 inches) of rubber tape (self amalgamating) and fit to the ground cable lug. Wrap the tape completely around the lug and cable.

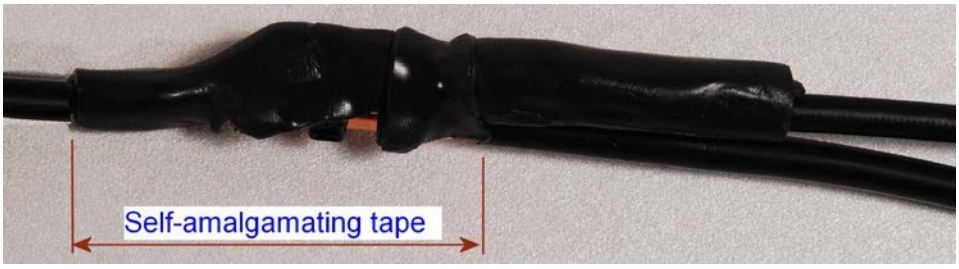


3 Fold the ground wire strap around the drop cable screen and fit cable ties.

4 Tighten the cable ties with pliers.

Cut the surplus from the cable ties.

5 Cut a 38mm (1.5 inches) section of self-amalgamating tape and wrap it completely around the joint between the drop and ground cables.



6 Use the remainder of the self-amalgamating tape to wrap the complete assembly. Press the tape edges together so that there are no gaps.

7 Wrap a layer of PVC tape from bottom to top, starting from 25 mm (1 inch) below and finishing 25 mm (1 inch) above the edge of the self-amalgamating tape, over lapping at half width.

8 Repeat with a further four layers of PVC tape, always overlapping at half width. Wrap the layers in alternate directions:

Second layer: top to bottom.

Third layer: bottom to top.

Fourth layer: top to bottom.

Fifth layer: bottom to top.

The edges of each layer should be 25mm (1 inch) above (A) and 25 mm (1 inch) below (B) the previous layer.

9 Prepare the metal grounding point of the supporting structure to provide a good electrical contact with the grounding cable clamp. Remove paint, grease or dirt, if present. Apply anti-oxidant compound liberally between the two metals.

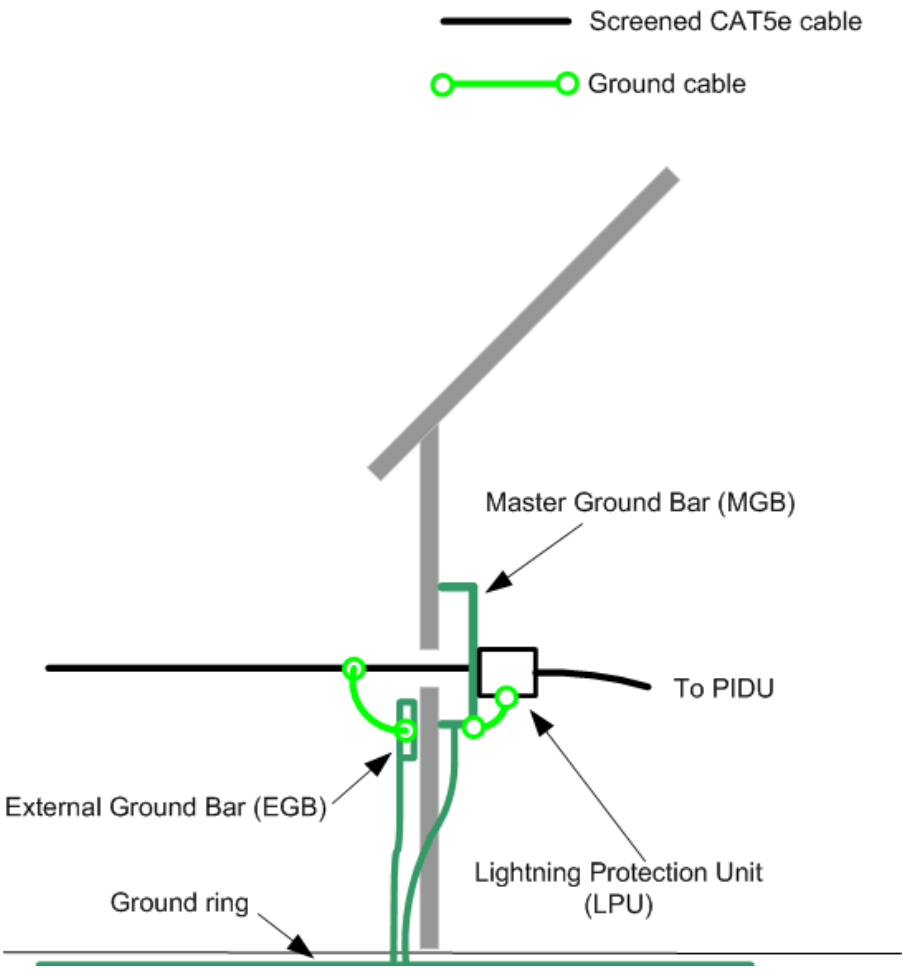
10 Clamp the bottom lug of the grounding cable to the supporting structure using site approved methods.

> **NOTE**
> Use a two-hole lug secured with fasteners in both holes. This provides better protection than a single-hole lug.

Installing and grounding the drop cable at building entry

Perform this procedure to install and ground the drop cable and LPU at the building (or cabinet) entry point (Figure 98).

Figure 98 Grounding at building entry



To run the drop cable into the building, proceed as follows:

1. Make an entry point into the building and run the main drop cable into the building.
2. Ground the drop cable to the external ground bar outside the building entry point, as described in Making a drop cable ground point on page 5-23.
3. Install the bottom LPU inside the building, not more than 600 mm (24 in) from the building entry point. Mount the LPU with cable glands facing downwards.
4. Ground the LPU to the master ground bar.

5 Cut any surplus length from the bottom end of the main drop cable and fit an RJ45 connector and gland, as described in Assembling an RJ45 connector and gland on page 5-18.

6 Connect the main drop cable to the LPU, as described in Connecting an RJ45 and gland to a unit on page 5-21.

7 Connect the LPU-PIDU drop cable to the other port of the LPU, as described in Connecting an RJ45 and gland to a unit on page 5-21.

8 Run the LPU-PIDU drop cable to the location of the PIDU (or PTP-SYNC).

NOTE

If it is necessary to disconnect the drop cable, refer to Disconnecting an RJ45 and gland from a unit on page 5-22.

Installing the PIDU

Perform this task to install the PIDU and connect it to the ODU and network cables.

This task consists of the following procedures:

- Mounting the PIDU on page 5-29
- Connecting the PIDU to the ODU cable on page 5-29
- Preparing the PIDU to LAN cable on page 5-31

Mounting the PIDU

Mount the PIDU on a wall or other suitable mounting surface, at a height that protects it from flooding or rising damp.

Mount it using the lugs provided, as this prevents the unit from being knocked or kicked and can help maintain link availability.

Ensure that the Recovery switch can be accessed when mounting the unit.

⚠ CAUTION

The PIDU is not waterproof and should be mounted away from sources of moisture. If mounted outdoors, the unit should be mounted in a moisture proof enclosure, preferably ventilated.

Connecting the PIDU to the ODU cable

The cable from the ODU is connected to the PIDU by means of a concealed RJ45 socket.

⚠ CAUTION

Plugging other equipment into the ODU RJ45 socket may damage the equipment due to the non-standard techniques employed to inject DC power into the 1000BaseT connection between the PIDU and the ODU. Plugging the ODU into other equipment may damage the ODU and/or the other equipment.

⚠ CAUTION

Do not dress the PIDU cables too tightly, as this may make the connections unreliable.

⚠ CAUTION

The connected network equipment must feature screened RJ45 connectors and must be connected to ground, otherwise the PIDU will not be grounded.

To connect the PIDU to the cable from the ODU, proceed as follows:

1. Form a drip loop on the PIDU end of the LPU-PIDU drop cable. The drip loop ensures that any moisture that runs down the cable into the cabinet or enclosure cannot enter the PIDU.

   This should be done first in order to avoid straining the RJ45 connector.

2. Fit an RJ45 connector (but no gland) to the PIDU end of the LPU-PIDU drop cable.

3. Undo the retaining screw and hinge back the cover.

4. Plug in the cable from the LPU (or PTP-SYNC if installed), ensuring that it snaps home.

> **NOTE**
> Depending upon the type of PIDU, the cover may hinge either vertically or horizontally.

5. Replace the cover and secure with the retaining screw.

Preparing the PIDU to LAN cable

Prepare the Cat5e cable that will connect the PIDU to the network equipment. This cable must meet the following requirements:

- Use either foil screen (FTP) or braided screen (STP) cable.
- Use screened RJ45 connectors with metal shells at both ends.
- Ensure there is a continuous electrical connection between both screened connectors.

⚠ CAUTION

The connected network equipment must feature screened RJ45 connectors and must be connected to ground, otherwise the PIDU will not be grounded

The PIDU is not normally connected to the network equipment until antenna alignment is complete. See Task 15: Connecting link to the network on page 6-99.

Installing a PTP-SYNC unit

If the chosen TDD synchronization method requires PTP-SYNC (see Configuration options for TDD synchronization on page 2-30), then perform this task to install a PTP-SYNC unit.

This task consists of the following procedures:

- Preparing for PTP-SYNC installation on page 5-32
- Mounting the PTP-SYNC unit on page 5-33
- Connecting up the PTP-SYNC unit on page 5-34
- Powering up the PTP-SYNC installation on page 5-36

⚠ CAUTION

The PTP-SYNC unit should not be installed in a domestic (home) environment as it is a Class A product. In a domestic environment, it may cause radio frequency (RF) interference in other appliances.

⚠ CAUTION

The PTP-SYNC unit must be installed indoors in a non-condensing environment, otherwise it will be prone to water damage.

⚠ CAUTION

To protect the PTP-SYNC from damage, disconnect the power supply from the PIDU before connecting up the PTP-SYNC.

Preparing for PTP-SYNC installation

Check that the correct components are available, as described in Ordering components on page 2-53.

Mounting the PTP-SYNC unit

Install the PTP-SYNC unit in the equipment building, either in a rack or on a wall.

Rack mounting

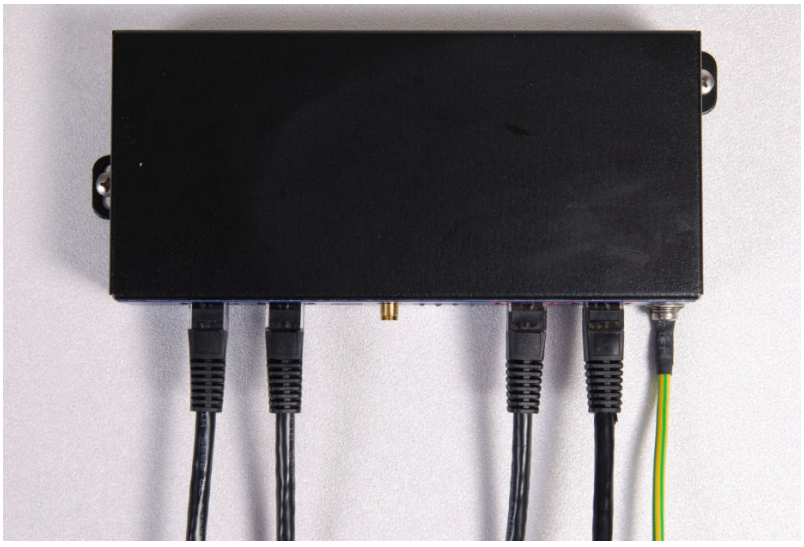
If the PTP-SYNC is to be in a rack, fix it to the rack mount using the M3 screws from the rack mount installation kit (Figure 99).

Figure 99 Rack mount securing screws for PTP-SYNC

Wall mounting

If the PTP-SYNC is to be on a wall, mount it vertically with interfaces and cabling facing downwards (Figure 100).

Figure 100 PTP-SYNC mounted on a wall



Connecting up the PTP-SYNC unit

To connect the PTP-SYNC to the PIDU, ODU, GPS receiver (if fitted), and LPU (if fitted), proceed as follows:

1 Disconnect the power supply from the PIDU.

2 If using GPS, connect the cable from the GPS unit to the GPS/SYNC IN port.

3 To link clustered PTP-SYNC units, connect the SYNC OUT port of the first PTP-SYNC to the GPS/SYNC IN port of the second PTP-SYNC in the chain. Repeat for subsequent PTP-SYNC units in the chain.

4 Connect the cable from the PIDU to the PIDU IN port. A suitable 1 meter cable is included in the PTP-SYNC kit.

5 Connect the cable from the ODU to the ODU OUT port.

6 Use a grounding cable to connect the ground stud of the PTP-SYNC to the master ground bar of the building, or to the rack ground bar.

Powering up the PTP-SYNC installation

To power up the installation, proceed as follows:

1. Ensure that all cables are connected to the correct interfaces of the PTP-SYNC unit and the GPS receiver (if used). Ensure that the installation is correctly grounded.

   ⚠ CAUTION
   Failure to do so may result in damage to the equipment.

2. Connect the power supply to the PIDU.
3. Within 90 seconds, the PTP-SYNC 'STATUS' LED should blink once every second to show that satellite lock has been achieved.
4. If the system does not operate correctly, refer to Testing PTP-SYNC on page 8-13.

Installing a GPS receiver for PTP-SYNC

If PTP-SYNC is to be installed with a GPS receiver as the timing reference source, then perform this task to install a GPS receiver.

This task consists of the following procedures:

- Mounting the GPS receiver on page 5-37
- Preparing GPS drop cables on page 5-38
- Assembling an RJ45 plug and housing for GPS on page 5-39
- Assembling a 12 way circular connector on page 5-42
- Installing the GPS drop cable on page 5-46
- Grounding the GPS drop cable on page 5-47
- Installing the GPS drop cable at building entry on page 5-49

⚠ CAUTION

Prior to power-up of equipment, ensure that all cables are connected to the correct interfaces of the PTP-SYNC unit and the GPS receiver module. Failure to do so may result in damage to the equipment.

Mounting the GPS receiver

Mount the GPS receiver (following manufacturer's instructions) upon either an external wall or a metal tower or mast. For more information on these options, refer to Mounting options for the PTP-SYNC GPS receiver on page 2-34.

Preparing GPS drop cables

Perform this task to prepare the Cat5e cables that connect the GPS to the PTP-SYNC.

CAUTION

Always use Cat5e cable that is gel-filled and shielded with copper-plated steel. Alternative types of cable are not supported by Cambium.

NOTE

The maximum permitted lengths of Cat5e cables are specified in Maximum cable lengths on page 2-7.

For details of supported cables and recommended connectors, refer to Ordering components on page 2-53.

'Main' drop cable: To prepare a long section of drop cable to connect the GPS to the LPU:

1. Cut off the approximate length required (allowing a bit of surplus), or leave it on the drum so that it can be unwound as the cable is hoisted.
2. Slide one or more hoisting grips onto to the top end of the GPS drop cable. To determine the number of hoisting grips required, consult the grip manufacturer.
3. Secure the hoisting grip to the cable using a special tool, as recommended by the manufacturer.
4. If a GPS adapter cable kit is available, attach the plug housing and an RJ45 plug to the top end of the main GPS drop cable, as described in Assembling an RJ45 plug and housing for GPS on page 5-39.
5. If a GPS adapter cable kit is not available, fit a 12 way circular connector to the top end of the main drop cable as described in Assembling a 12 way circular connector on page 5-42.

'LPU-PTP-SYNC' drop cable: To prepare a short section of drop cable to connect the LPU to the PTP-SYNC: cut off the approximate length required (allowing a bit of surplus), then fit an RJ45 connector and gland to the LPU end only, as described in Assembling an RJ45 connector and gland on page 5-18.

Assembling an RJ45 plug and housing for GPS

This procedure is only performed when a GPS adapter cable kit is available. This kit is used to connect the Trimble Acutime™ Gold GPS receiver to the GPS drop cable.

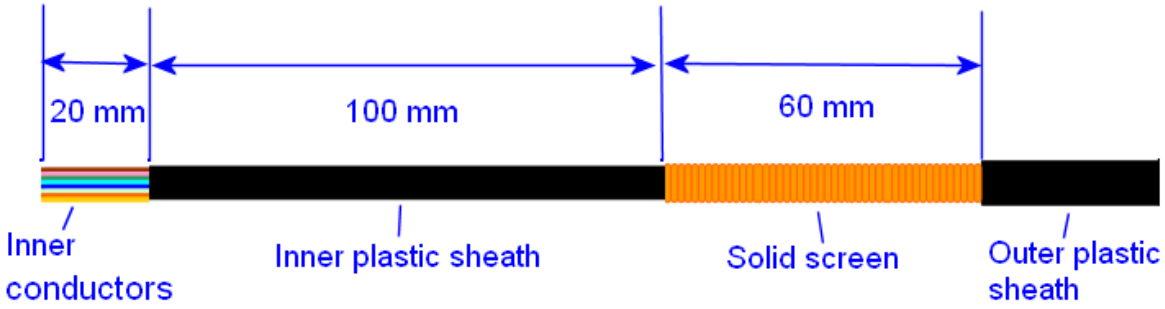
The kit contains an adapter cable (GPS receiver circular connector to RJ45 socket) and an RJ45 plug housing. The plug housing should be assembled over the end of the drop cable to provide a sealed connection to the adapter cable.

NOTE

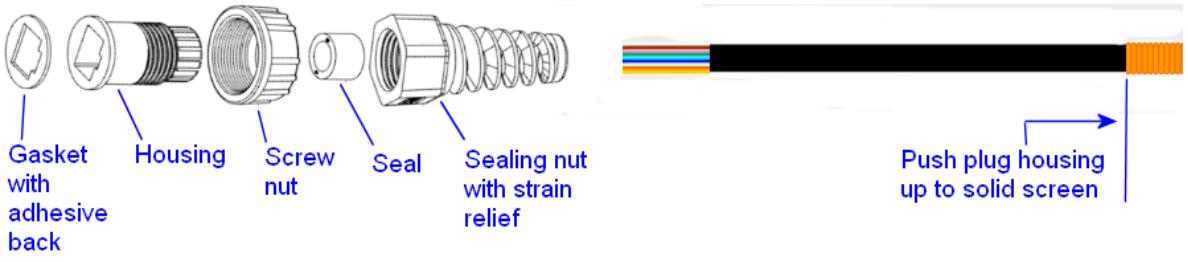
These instructions are for the preparation of the Cambium-supplied drop cable type (Superior Essex BBDGE). Other types of cable may need different preparation methods.

To assemble the plug housing over the end of the drop cable, proceed as follows:

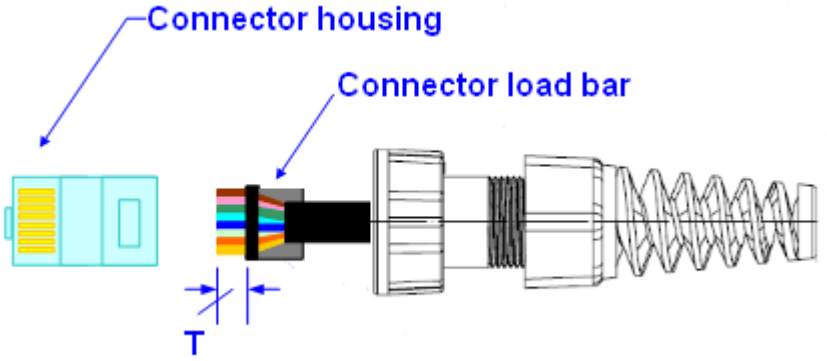
1 Prepare the top end of the GPS drop cable.



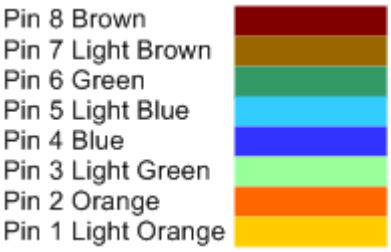
2 Install plug housing from the converter kit onto the prepared cable. Do not tighten the nuts at this stage.



3 Install the RJ45 crimp plug.



Start with tails over-length to assist insertion into load bar, then trim them to 5 mm (T). Connect the RJ45 pins to the following conductors (Superior Essex BBDGe colors):

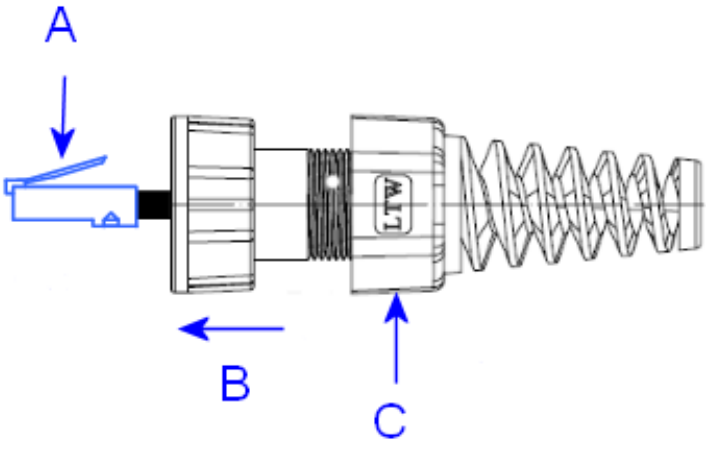


4 Assemble plug housing:

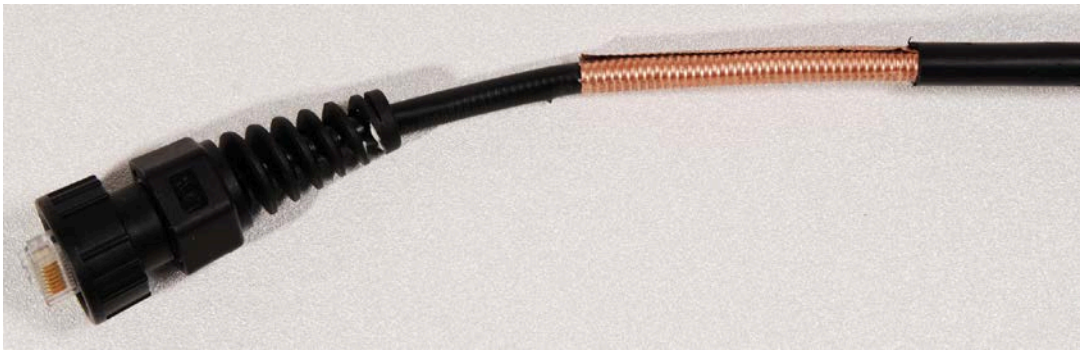
Depress the RJ45 locking tab (A).

Slide the plug housing assembly (B) over the RJ45 plug.

Tighten the sealing nut (C). This is easier to fully tighten when the plug housing is mated to the socket of the adapter cable.



5 Check the assembly. This is an exampled of an assembled plug housing on the end of a drop cable:



Assembling a 12 way circular connector

This procedure is only performed when a GPS adapter cable kit is NOT available.

A 12 way circular connector must be connected to the top end of the main GPS drop cable.

NOTE
This procedure requires a soldering iron and solder.

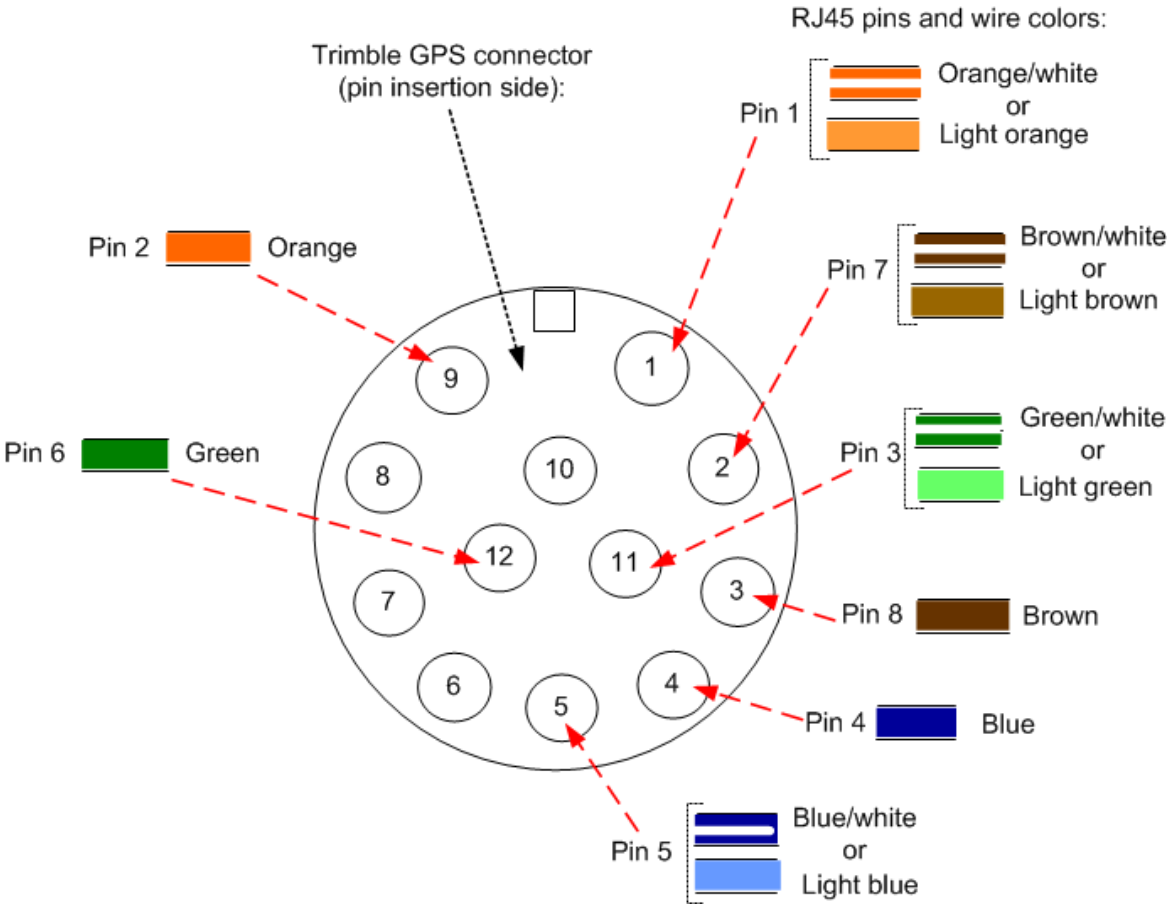
CAUTION
The drop cable has solid copper conductors. There are a limited number of times each conductor can be bent before it fatigues and fails.

Table 97 shows how the 12 way circular connector locations map to the PTP-SYNC RJ45 pins. Figure 101 illustrates this mapping.

Table 97 GPS 12 way circular connector to RJ45 pin mappings

GPS connector location	Function	Cat5e wire color		PTP-SYNC (J10) RJ45 pin	PTP-SYNC signal name
		Conventional	Supported drop cable		
1	DC Pwr (12V)	Orange/White	Light Orange	1	12VGPS
2	RxB-	Brown/White	Light Brown	7	GPS_TXDA
3	RxB+	Brown	Brown	8	GPS_TXDB
4	TxB-	Blue	Blue	4	GPS_RXDA
5	TxB+	Blue/White	Light Blue	5	GPS_RXDB
6	RxA-	N.C	N.C	---	
7	RxA+	N.C	N.C	---	
8	TxA-	N.C	N.C	---	
9	DC Ground	Orange	Orange	2	GND
10	TxA+	N.C	N.C	---	
11	Tx1PPS+	Green/White	Light Green	3	GPS_1PPSA
12	Tx1PPS-	Green	Green	6	GPS_1PPSB

Figure 101 Inserting RJ45 pins into the 12 way circular connector



To connect the drop cable to the 12 way circular connector, proceed as follows:

1 Prepare the drop cable end as follows:

Bare back the cable outer and copper screen to 50mm.

Bare back the cable inner to 17mm.

Un-twist the cable pairs.

Strip the individual conductors to 5mm.

2 Fit the plug outer, associated boot, and boot insert.

3 Connect the socket contacts using either of the following techniques:

Crimp

Crimp the socket contacts onto each of the conductors using the correct crimp tool and positioner, setting the wire size selector to ‘3’ for 24AWG wire.

Solder

When soldering the socket contacts onto each of the conductors, ensure that there is no solder or flux residue on the outside of the contact. Care should also be taken that the individual conductor insulation does not peel back with the soldering heat, allowing possible shorts when assembled into the plug shell.

4 Fit four ‘dummy’ contacts into the unused 12 way circular connector locations (6, 7, 8 and 10), to provide strength and sealing. Push the contacts in from the pin insertion side.

Pin insertion side: Plug mating side:

5 Insert the eight RJ45 contact pins into the pin insertion side of the 12 way circular connector in accordance with Figure 101.

It is easiest to insert the pins from the center out, in descending order of Trimble location number, that is, 12, 11, 9, 5, 4, 3, 2, 1. Push the contacts in so that the shoulder on the contact fits into the hole in the plug shell. When all contacts have been fitted, push them in further to engage with the locking mechanism in the plug shell. This can be done by applying pressure to the contact with a small diameter stiff object, such as tweezers.

> **NOTE**
> If a contact is pushed in to the point where the locking mechanism engages before all of the contacts have been inserted it will limit the amount of room available to fit the remaining contacts, requiring harder bends to be applied.

6 Fit the plug to its shell. The plastic ring fits inside the rubber boot and ensures a tight fit when the plug body is clipped onto the plug shell. Be aware that the plug body is a hard push fit onto the plug shell.

7 Fit the strain relief clip.

Installing the GPS drop cable

Perform this procedure to install the main GPS drop cable, connect it to the GPS, and ground it to the supporting structure.

To install the main GPS drop cable, proceed as follows:

1 Hoist the main GPS drop cable up to the GPS unit using the hoisting grip and a hoist line. When the cable is in position and the grip handle is fastened to the supporting structure, remove the hoist line.

2 If a GPS adapter cable is available, use it to connect the main GPS drop cable to the GPS unit.

3 If a GPS adapter cable is not available, connect the main GPS drop cable to the GPS unit via a 12 way circular connector. Weatherproof the connection as follows:

Wrap a layer of self-amalgamating tape, starting 25mm below the bared back outer of the cable and finishing at the GPS housing.

Wrap a layer of PVC tape, starting just below the start of the self-amalgamating tape and finishing at the GPS housing, overlapping at half width.

Repeat with four more layers of PVC tape alternating the start and finish ends.

4 Lay the main drop cable as far as the building entry point, ensuring there is enough length to extend through the wall of the building to the LPU.

5 Attach the main GPS drop cable to the supporting structure using site approved methods.

Grounding the GPS drop cable

Ground the drop cable to the supporting structure at the points shown in Figure 40 (wall installation) or Figure 41 (mast or tower installation). See Making a drop cable ground point on page 5-23.

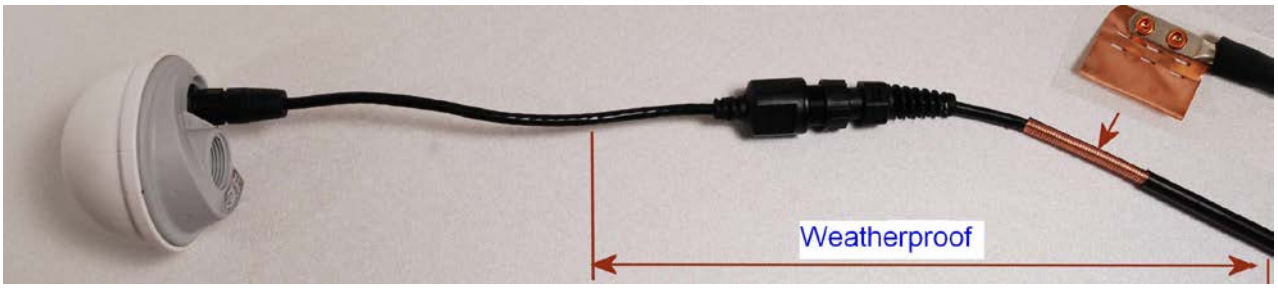
NOTE

A mast or tower may require additional grounding points, as specified in Protection requirements for a mast or tower installation on page 2-24.

Top grounding point when using GPS adapter cable

If a GPS adapter cable has been installed (Figure 102), ground the drop cable at the point where the solid screen is already exposed, and weatherproof both the ground cable joint and the RJ45 connection.

Figure 102 Grounding and weatherproofing requirements for GPS adapter cable



Follow the procedure described in Making a drop cable ground point on page 5-23, but observe the following differences:

- There is no need to remove 60mm (2.5inches) of the drop cable outer sheath, as this has already been done.
- Wrap the top layer of self-amalgamating tape around the complete assembly (not just the ground cable joint), including the RJ45 connection with the GPS adapter cable (Figure 103).
- Wrap all five layers of PVC tape around the complete assembly (Figure 104). Wrap the layers in alternate directions: (1st) bottom to top; (2nd) top to bottom; (3rd) bottom to top; (4th) top to bottom; (5th) bottom to top. The edges of each layer should be 25mm (1 inch) above (A) and 25 mm (1 inch) below (B) the previous layer.

Figure 103 Wrapping self-amalgamating tape around the GPS adapter cable joint

Figure 104 Wrapping PVC tape around the GPS adapter cable joint

Check that the joint between the GPS adapter cable, drop cable and ground cable is fully weatherproofed (Figure 105).

Figure 105 Grounding and weatherproofing example for GPS adapter cable

Installing the GPS drop cable at building entry

Install and ground the main GPS drop cable and LPU at the building (or cabinet) entry point, and install the LPU-PTP-SYNC drop cable, as described in Installing and grounding the drop cable at building entry on page 5-27.

Connect this cable to the PTP-SYNC unit as described in Connecting up the PTP-SYNC unit on page 5-34.

Installing an E1 or T1 interface

Perform this task to install an optional E1 or T1 interface.

This task consists of the following procedures:

- Preparing for E1 or T1 installation on page 5-50
- Installing E1 or T1 on page 5-50
- Testing the E1/T1 installation on page 5-53

Preparing for E1 or T1 installation

Check that the correct components are available, as described in Ordering components on page 2-53.

⚠ CAUTION

To prevent damage to the ODU while making or breaking the connections, ensure that power is removed from the system at the PIDU.

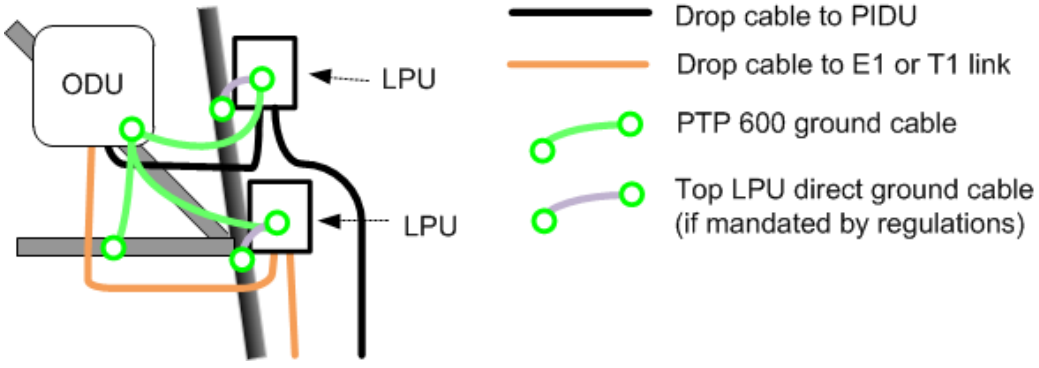
NOTE

The maximum permitted lengths of E1 or T1 cables are specified in Maximum cable lengths on page 2-7.

Installing E1 or T1

To install an E1 or T1 interface, proceed as follows:

1 Mount the top LPU for the E1 or T1 interface close to the ODU, using the U-bolt bracket supplied with the PTP LPU kit.



2 Connect and ground the top LPU for E1 or T1. The procedure is similar to that described in Connecting and grounding the ODU and top LPU on page 5-8, with the following differences:

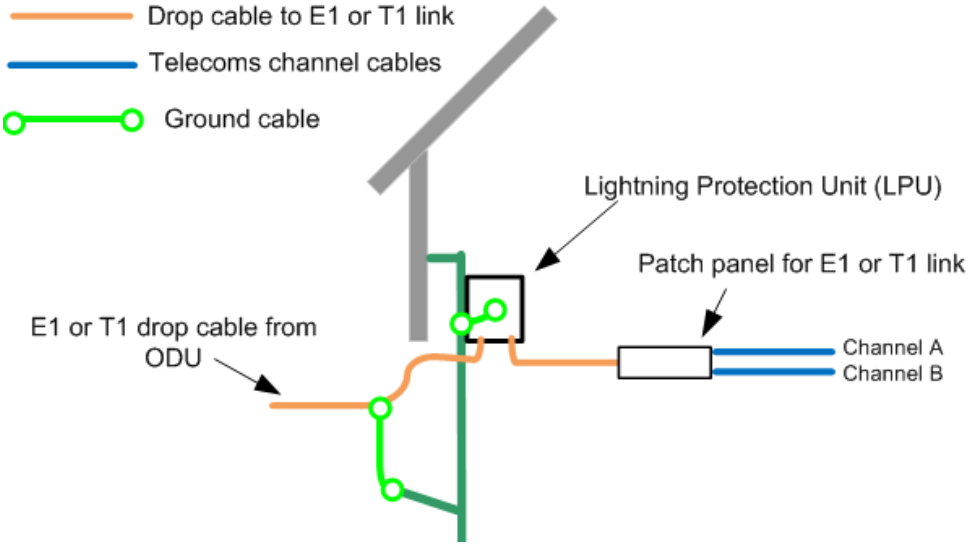
Connect the E1/T1 back-to-back cable to the E1/T1 port of the ODU.

Connect a ground cable from the ODU to the E1/T1 top LPU.

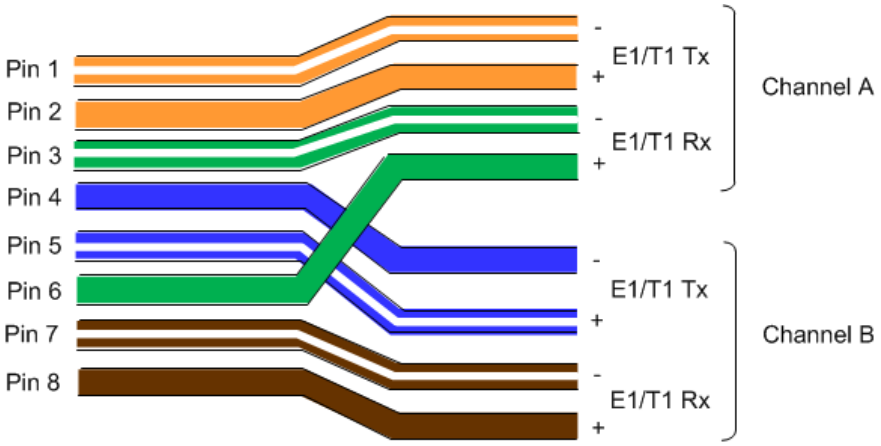
If mandated by local regulations, then connect a ground cable from the E1/T1 top LPU to the grounding system.

3 Install the main drop cable for E1 or T1 by following the procedure described in Installing the drop cable and bottom LPU on page 5-16.

4 Install the bottom LPU for E1 or T1. The procedure is similar to that described in Installing and grounding the drop cable at building entry on page 5-27, except that the short drop cable is run to the site of the E1 or T1 patch panel.


Drop cable to E1 or T1 link
Telecoms channel cables
Ground cable
Lightning Protection Unit (LPU)
Patch panel for E1 or T1 link
E1 or T1 drop cable from ODU
Channel A
Channel B

5 Configure the patch panel to connect the E1 or T1 drop cable to the telecoms channels. The telecoms connection pin outs are specified in Table 98.



NOTE

If it is necessary to disconnect the E1/T1 cable from the ODU, refer to Disconnecting an RJ45 and gland from a unit on page 5-22.

Table 98 E1 or T1 patch panel pin outs

E1 or T1 drop cable RJ45 pin number	Connector Pinout Signal Name	120 Ohm signal balanced twisted pair RJ45 pin number	120 Ohm signal balanced twisted pair description	Telecoms channel
Pin 1	E1T1A_TX-	Pin 2	Rx Ring	A
Pin 2	E1T1A_TX+	Pin 1	Rx Tip	A
Pin 3	E1T1A_RX-	Pin 5	Tx Ring	A
Pin 4	E1T1B_TX-	Pin 2	Rx Ring	B
Pin 5	E1T1B_TX+	Pin 1	Rx Tip	B
Pin 6	E1T1A_RX+	Pin 4	Tx Tip	A
Pin 7	E1T1B_RX-	Pin 5	Tx Ring	B
Pin 8	E1T1B_RX+	Pin 4	Tx Tip	B

Baluns

The patch panel may include a Balun for transmission over 75 Ohm co-axial unbalanced lines. The Balun should conform to the requirements of ITU G703. An example of a Balun is shown in Figure 106. It allows the transmit and receive data carried over a 75 Ohm cable to be converted to a balanced form for transmission over a 120 Ohm signal balanced twisted pair. The balancing of E1/T1 120 Ohm signals is illustrated in Table 98.

Figure 106 Example of a Balun

Testing the E1/T1 installation

Test the telecoms links by performing loopback connection tests as described in Performing a telecoms loopback test on page 8-16.

Before connecting the E1/T1 source, check the following resistances:

- Check the cable resistance between pins 3 & 6 (Green/White & Green) and 7 & 8 (Brown/White & Brown). Check against Table 99 column 2.
- Check the cable resistance between pins 1 & 2 (Orange/White & Orange) and 4 & 5 (Blue & Blue/White). Check against Table 99 column 3.

Table 99 Resistance referenced to the E1/T1 source

CAT-5 Length (Meters)	Resistance between pins 3 & 6 and pins 7 & 8 (ohms)	Resistance between pins 1 & 2 and pins 4 & 5 (ohms)
0	0.8	1.3
10	2.5	3.0
20	4.2	4.7
30	5.9	6.4
40	7.6	8.2
50	9.3	9.8
60	11.0	11.5
70	12.7	13.2

CAT-5 Length (Meters)	Resistance between pins 3 & 6 and pins 7 & 8 (ohms)	Resistance between pins 1 & 2 and pins 4 & 5 (ohms)
80	14.4	14.9
90	16.1	18.2
100	17.8	18.3

Installing an OOBM interface

Perform this task to install an optional out-of-band management (OOBM) interface. Out-of-band management is only available in the PTP 45600, PTP 54600 OOBM and PTP 58600 OOBM product variants.

This task consists of the following procedures:

- Preparing for OOBM installation on page 5-55
- Installing OOBM on page 5-55

Preparing for OOBM installation

Check that the correct components are available, as described in Ordering components on page 2-53.

CAUTION

To prevent damage to the ODU while making or breaking the connections, ensure that power is removed from the system at the PIDU.

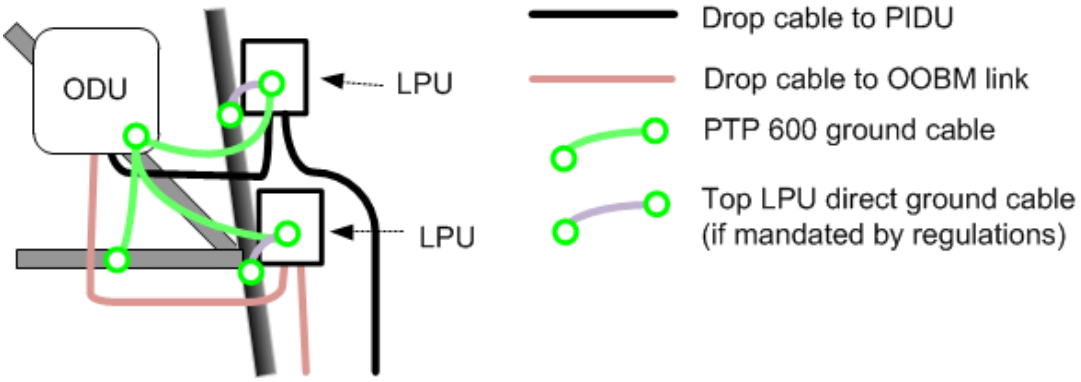
NOTE

The maximum permitted lengths of OOBM cables are specified in Maximum cable lengths on page 2-7.

Installing OOBM

To install an OOBM interface, proceed as follows:

1 Mount the top LPU for the OOBM interface close to the ODU, using the U-bolt bracket supplied with the PTP LPU kit.



2 Connect and ground the top LPU for OOBM. The procedure is similar to that described in Connecting and grounding the ODU and top LPU on page 5-8, with the following differences:

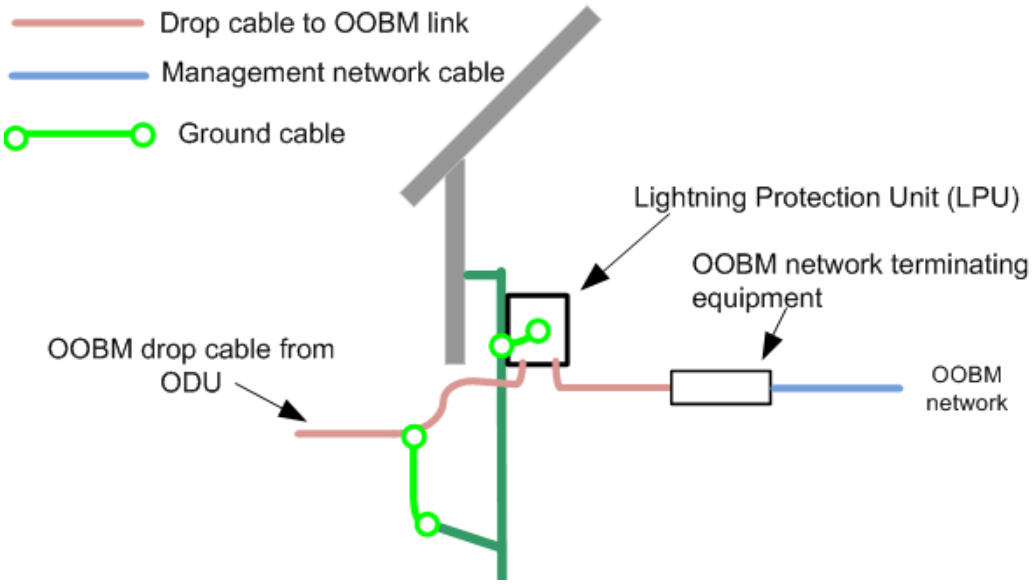
Connect the OOBM back-to-back cable to the AUX port of the ODU.

Connect a ground cable from the ODU to the OOBM top LPU.

If mandated by local regulations, then connect a ground cable from the OOBM top LPU to the grounding system.

3 Install the main drop cable for OOBM by following the procedure described in Installing the drop cable and bottom LPU on page 5-16.

4 Install the bottom LPU for OOBM. The procedure is similar to that described in Installing and grounding the drop cable at building entry on page 5-27, except that the short drop cable is run to the site of the OOBM network terminating equipment.



NOTE

If it is necessary to disconnect the OOBM cable from the ODU, refer to Disconnecting an RJ45 and gland from a unit on page 5-22.

Installing a fiber interface

Perform this task to install an optional fiber optic interface.

Optical safety precautions

⚠ WARNING

The kit contains a Class 1 Laser product. When installing this product, observe the safety precautions in this section.

Do not look into the laser beam

Do not look into the source of the laser beam (fiber receptacle) directly or through a fiber system, as this is highly likely to damage vision.

Remove the power supply

Always remove power from the system before the fiber optic connection is made or unmade.

Cap the connector

When installing the Fiber interface, take either of the following precautions:

- Cap the fiber connector, or
- Mate the connector to an appropriate equipment connector.

Label the indoor end

Ensure that the ‘indoor’ end of the fiber is appropriately labeled to ensure that service personnel are aware the same Class 1 Laser hazard could exist at the indoor end of the cable.

Inserting the SFP fiber module

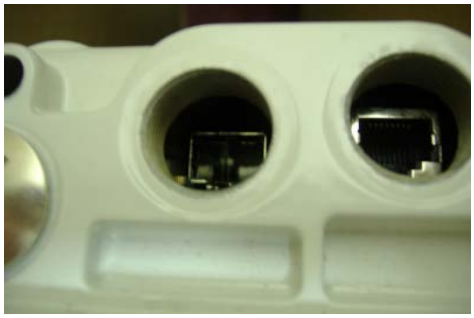
⚠ CAUTION

The SFP fiber module may be damaged by ESD. It is supplied in an ESD protective case. Observe ESD handling procedures when unpacking and installing the module.

The performance of 1000BaseSX and 1000Base LX connections can be seriously affected by dust build up. Keep all dust covers in place until just before the connection is to be made.

To insert the SFP module into the ODU, proceed as follows:

1. Remove the blanking plug from the FIBER port of the ODU.



2. Insert the SFP Module into the SFP receptacle of the FIBER port with the PCB connector down and label up, as shown.

3. Push the module home until it clicks into place.

4 Remove the fiber dust protection cap.

Connecting the fiber optic cable

> **⚠ CAUTION**
> The fiber optic cable assembly is very delicate. To avoid damage, handle it with extreme care. Ensure that the fiber optic cable does not twist during assembly, especially when fitting and tightening the weatherproofing gland.

To connect the fiber optic cable to the SFP module, proceed as follows:

1 Thread the gland and extension tube over the fiber optic cable as shown.

Thread the gland onto the fiber optic cable before termination. It is possible to thread the LC connectors through the gland by separating the rubber seal into its component parts, then stretching them open with a sleeve spreading tool.

2 Remove the dust caps and plug the LC connectors into the SFP fiber module, ensuring that they snap home.

3 Fit the extension tube and tighten to hand tight plus 1/8 of a turn.

4 Fit the weatherproof gland body and tighten to hand tight plus 1/8 of a turn.

5 Fit the weatherproof gland nut and tighten until the rubber part of the gland gives a good seal around the cable.

6 Do not over-tighten the gland, as there is a risk of damage to its internal seal and structure.

Removing the fiber optic cable

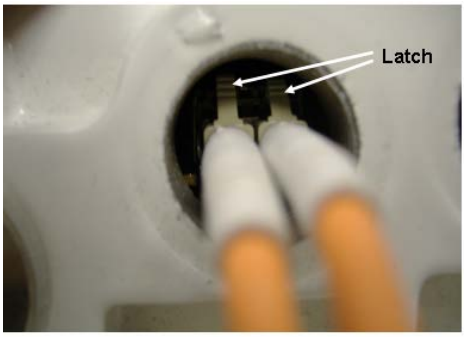
To remove the fiber optic cable assembly the above procedure should be reversed. The LC connectors are removed by pressing their release tabs. When removing the LC connectors, take special care to ensure that the release mechanism does not snag on the threaded part of the hole in the ODU enclosure.

Removing the SFP fiber module

Before attempting to remove the module, remove the fiber optic cable as described above.

To remove the SFP module from the ODU, proceed as follows:

1 Locate the plastic latches in the LC connectors.



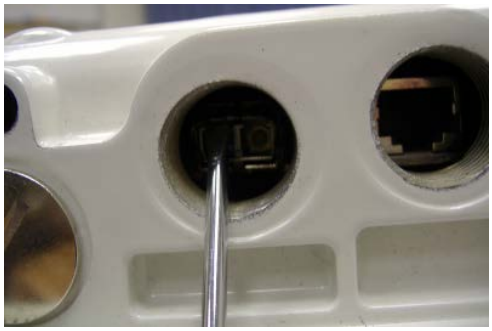
2 Using a screwdriver, push downwards to release the cables as shown.

3 Locate the latch release mechanism of the SFP module.

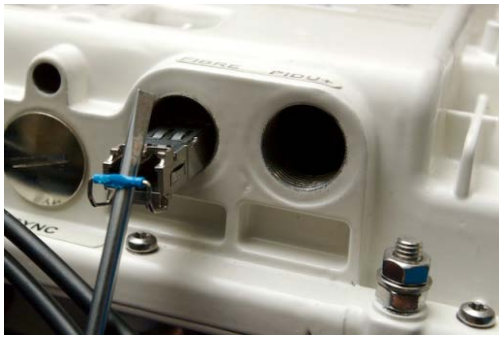
1000BaseLX :

1000BaseSX:

4 Using a screwdriver, release the SFP module latch with an upwards push.



5 Remove the SFP module from the receptacle.



Chapter 6: Configuration and alignment

This chapter describes all configuration and alignment tasks that are performed when a PTP 600 link is deployed.

Observe the precautions in Preparing for configuration and alignment on page 6-2.

Configure the two units ('Master' and 'Slave') by performing the following tasks:

- Task 1: Connecting to the unit on page 6-3
- Task 2: Configuring IP and Ethernet interfaces on page 6-7
- Task 3: Installing license keys on page 6-14
- Task 4: Upgrading software version on page 6-17
- Task 5: Configuring security on page 6-21
- Task 6: Configuring wireless and telecoms interfaces on page 6-45
- Task 7: Setting up SNMP agent on page 6-63
- Task 8: Configuring alarms and messages on page 6-77
- Task 9: Configuring syslog on page 6-81
- Task 10: Configuring remote access on page 6-83

When all equipment has been installed at both link ends, perform the following tasks:

- Task 11: Aligning antennas on page 6-85
- Task 12: Updating system configuration on page 6-92
- Task 13: Checking wireless performance on page 6-95
- Task 14: Configuring quality of service on page 6-96
- Task 15: Connecting link to the network on page 6-99
- Task 16: Configuring the fiber interface on page 6-105
- Task 17: Saving the system configuration on page 6-110

> **NOTE**
> If FIPS 140-2 secure mode is required, refer to Configuring for FIPS 140-2 applications on page 6-111. If UC APL secure mode is required, refer to Configuring for UC APL applications on page 6-114.

Preparing for configuration and alignment

This section describes the checks to be performed before proceeding with unit configuration and antenna alignment.

Safety precautions during configuration and alignment

All national and local safety standards must be followed while configuring the units and aligning the antennas.

⚠ WARNING

Ensure that personnel are not exposed to unsafe levels of RF energy. The units start to radiate as soon as they are powered up. Respect the safety standards defined in Compliance with safety standards on page 4-51, in particular the minimum separation distances.

Observe the following guidelines:

- Never work in front of the antenna when the ODU is powered.
- Always power down the PIDU before connecting or disconnecting the drop cable from the PIDU, ODU or LPU.

Regulatory compliance during configuration and alignment

All applicable radio regulations must be followed while configuring the units and aligning the antennas. For more information, refer to Compliance with radio regulations on page 4-58.

⚠ CAUTION

USA only: if the system designer has provided a list of channels to be barred for TDWR radar avoidance, the affected channels must be barred during staging, before the units are allowed to radiate on site, otherwise FCC rules will be infringed.

Selecting configuration options

Use the installation report to determine which configuration options are required. Refer to PTP LINKPlanner on page 2-12.

Task 1: Connecting to the unit

This task consists of the following procedures:

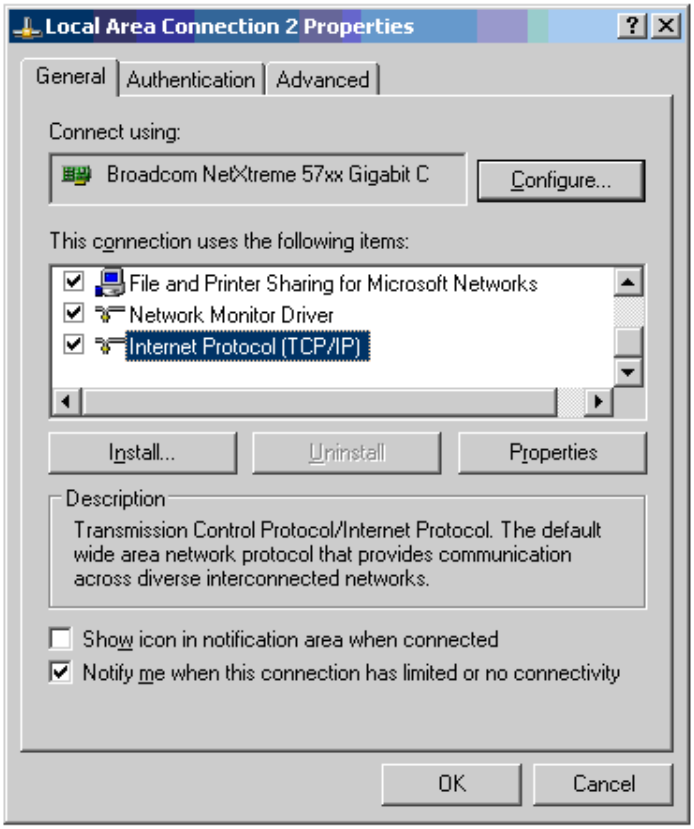
- Configuring the management PC on page 6-3
- Connecting to the PC and powering up on page 6-5
- Logging into the web interface on page 6-5

Configuring the management PC

To configure the local management PC to communicate with the PTP 600, proceed as follows:

1 Select **Properties** for the Ethernet port.

2 Select the Internet Protocol (TCP/IP) item:

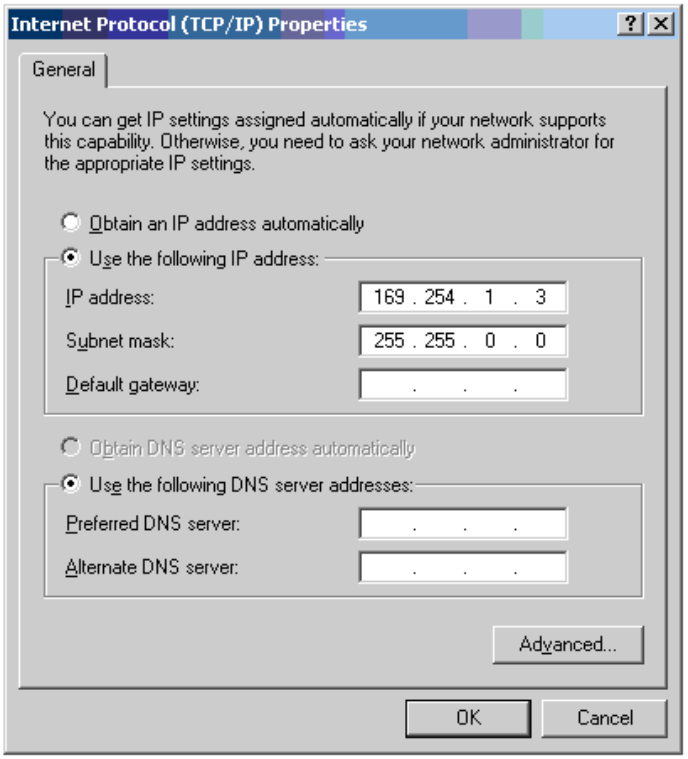


3 Click on **Properties**.

4 Enter an IP address that is valid for the 169.254.X.X network, avoiding:

169.254.0.0 and 169.254.1.1 and 169.254.1.2

A good example is 169.254.1.3:


Internet Protocol (TCP/IP) Properties
General
You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.
Obtain an IP address automatically
Use the following IP address:
IP address:
169 . 254 . 1 . 3
Subnet mask:
255 . 255 . 0 . 0
Default gateway:
Obtain DNS server address automatically
Use the following DNS server addresses:
Preferred DNS server:
Alternate DNS server:
Advanced...
OK
Cancel

5 Enter a subnet mask of 255.255.0.0.

Leave the default gateway blank.

Connecting to the PC and powering up

To connect the PTP 600 to the PC and power up the unit, proceed as follows:

1. Check that the ODU and PIDU are correctly connected.
2. Connect the PC Ethernet port to the LAN port of the PIDU using a standard (not crossed) Ethernet cable.
3. Apply mains or battery power to the PIDU. The green Power LED should illuminate continuously.
4. After about 45 seconds, check that the orange Ethernet LED starts with 10 slow flashes.
5. Check that the Ethernet LED then illuminates continuously.

NOTE

If the Power and Ethernet LEDs do not illuminate correctly, refer to Testing link end hardware on page 8-2.

Logging into the web interface

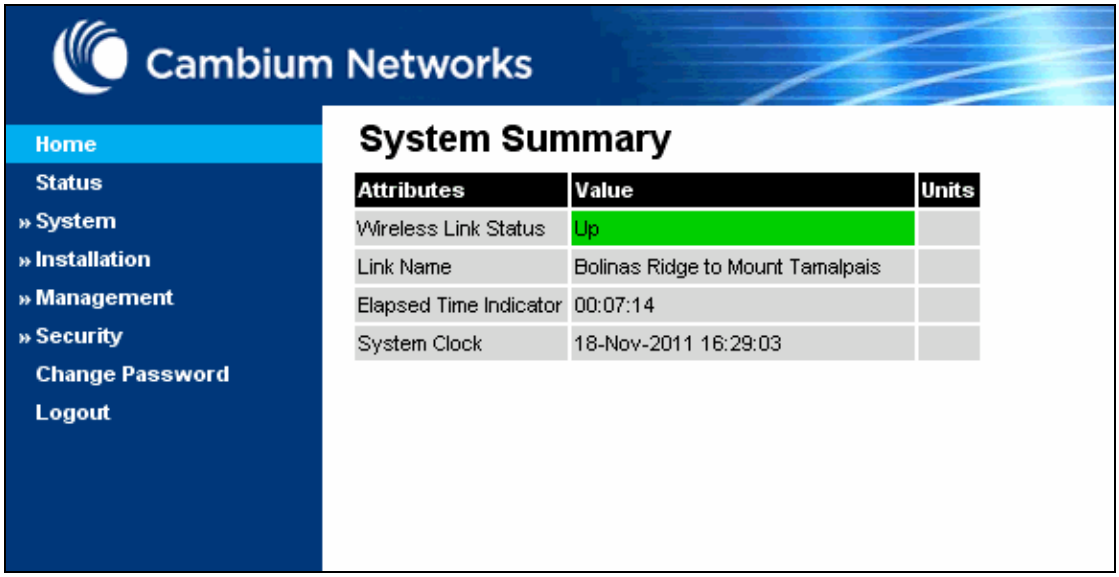
NOTE

If a PTP 600 link has been purchased, one unit will be factory configured as a Master unit with an IP address of 169.254.1.2. The other unit will be factory configured as a Slave unit with an IP address of 169.254.1.1.

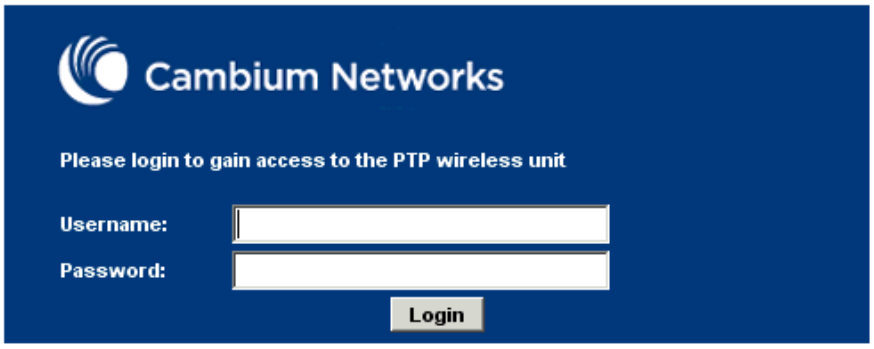
If a single PTP 600 unit has been purchased, it will be factory configured as a Slave unit with an IP address of 169.254.1.1.

To log into the web interface as a system administrator, proceed as follows:

1. Start the web browser from the management PC.
2. Type the IP address of the unit into the address bar. The factory default IP address will be either 169.254.1.1 or 169.254.1.2. Press ENTER. The web interface menu and System Summary page are displayed:



3. Select menu option **System Administration**. The login page is displayed:



4. Leave the Password blank and select **Login**.
5. Check that the PIDU Ethernet LED blinks randomly as traffic passes through. If it does not illuminate correctly, refer to Testing link end hardware on page 8-2.

Task 2: Configuring IP and Ethernet interfaces

This task consists of the following procedures:

- Configuring the IP interface and management mode on page 6-7
- Reconnecting to the management PC on page 6-13
- Configuring quality of service on page 6-96

Configuring the IP interface and management mode

The IP interface allows users to connect to the PTP 600 web interface, either from a locally connected computer or from a management network.

CAUTION

Before setting Management Mode to ‘Out-of-Band’ or ‘In-Band’, ensure that the Master and Slave units are configured with different IP addresses, otherwise the management agent will not be able to distinguish the two units.

CAUTION

Forcing Ethernet configuration is a last resort that should only be selected if problems are experienced with auto-negotiation.

The Ethernet Auto Negotiation and Auto Neg Advertisement attributes must have the same settings in the PTP 600 and in connected network equipment. If they are not consistent, then a duplex mismatch will occur, resulting in greatly reduced data capacity.

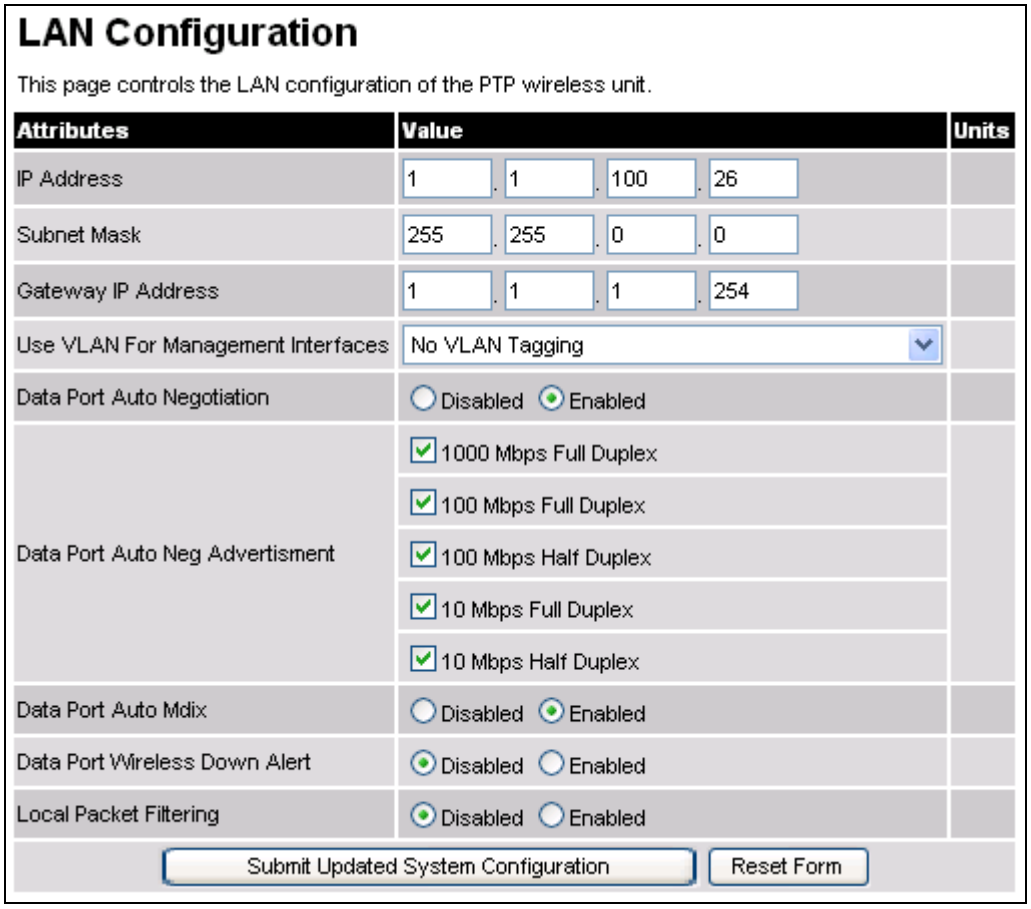
The Auto Neg Advertisement data rate must be within the capability of the connected network equipment, otherwise loss of service will occur.

NOTE

To configure the Ethernet link to run at a fixed speed and duplex, leave Ethernet Auto Negotiation set to ‘Enabled’ and set Auto Neg Advertisement to the required speed.

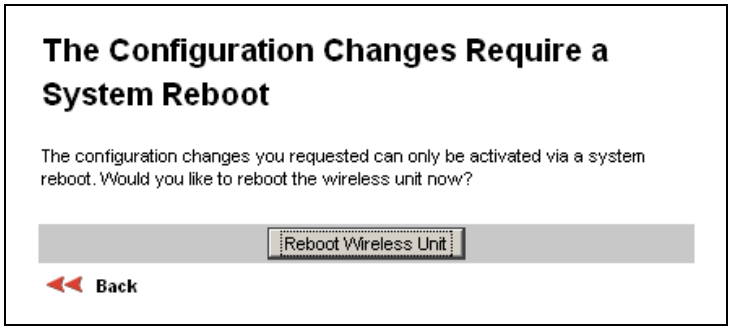
To configure the IP interface, proceed as follows:

1. Select menu option **System, Configuration, LAN Configuration**. The LAN configuration page is displayed:



2. Update IP Address, Subnet Mask and Gateway IP Address to meet network requirements (as specified by the network administrator).
3. Review the other IP interface attributes and update them, if required (Table 100).
4. If Management Mode has been set to ‘Out-of-Band Local’ or ‘Out-of-Band’, review and update the management port attributes (Table 101).
5. Review and update the data port attributes (Table 102).
6. Review and update the bridging attributes (Table 103).

7 Select **Submit Updated System Configuration**. The reboot verification page is displayed:


The Configuration Changes Require a System Reboot
The configuration changes you requested can only be activated via a system reboot. Would you like to reboot the wireless unit now?
Reboot Wireless Unit
Back

8 Select **Reboot Wireless Unit** and then **OK** to confirm the reboot.

Table 100 IP interface attributes

Attribute	Meaning
IP Address	Internet protocol (IP) address. This address is used by the family of Internet protocols to uniquely identify this unit on a network.
Subnet Mask	Defines the address range of the connected IP network.
Gateway IP Address	The IP address of a computer on the current network that acts as a gateway. A gateway acts as an entrance and exit to packets from and to other networks.
Use VLAN For Management Interfaces	This controls whether or not the management interfaces (WWW/SNMP/SMTP/SNTP) use VLAN tags. **⚠ CAUTION** Ensure that the configured VLAN is accessible, otherwise it will not be possible to access the unit following the next reboot. The PTP 600 management function is only compatible with single VLAN tagged packets. Any management packet with two or more packets will be ignored.
VLAN Management VID	Only displayed when 'Use VLAN for Management Interfaces' is enabled. Enter the VLAN VID (range 0 to 4094) that will be included in Ethernet frames generated by the management interfaces.
VLAN Management Priority	Only displayed when 'Use VLAN for Management Interfaces' is enabled. Enter the VLAN priority (range 0 to 7) that will be included in Ethernet frames generated by the management interfaces.

Attribute	Meaning
Management Mode	'Out-of-Band Local' means that the web interface can be reached from the management port (AUX) at the local unit only. This mode allows the construction of a management network that is isolated from the customer network. For more information, see Out-of-band local management on page 1-41. 'Out-of-Band' means that the web interface can be reached from the management port (AUX) at both the local and remote units (assuming that the wireless link is established). For more information, see Out-of-band management on page 1-41. NOTE 'Out-of-Band Local' and 'Out-of-Band' are only available when the unit is an OOBM hardware variant. 'In-Band' means that the web interface can be reached from the data port (PIDU+) at both the local and remote units (assuming that the wireless link is established). This is the default mode. For more information, see In-band management on page 1-40. 'In-Band Local' means that the web interface can be reached from the data port (PIDU+) at the local unit only. If this is selected, ensure that the same VLAN Management VID is configured at both ends of the link. Only displayed when Use VLAN for Management Interfaces is enabled. For more information, see In-band local management on page 1-40.

Table 101 Management port attributes

Attribute	Meaning
Management Network Access Enabled	Only displayed when Management Mode is set to 'Out-of-Band'. 'Yes' means that the local out-of-band interface can be used to access the remote management network. 'No' means that the local management agent can still be accessed from the remote management network and the local Out-of-Band interface.
Management Port Auto Negotiation	'Enabled' means that configuration of the out-of-band management Ethernet interface is automatically negotiated. This is the default setting. 'Disabled' means that configuration is forced. Use the same setting for both ends of the link.

Attribute	Meaning
Management Port Auto Neg Advertisement	Only displayed when Management Port Auto Negotiation is set to 'Enabled'. Select the data rate that the auto-negotiation mechanism will advertise as available on the the out-of-band management Ethernet interface. Use the same setting for both ends of the link. Only select a data rate that is within the capability of connected network equipment, otherwise loss of service may occur. The new setting will only take effect after a system reboot.
Management Port Forced Configuration	Only displayed when Management Port Auto Negotiation is set to 'Disabled'. This forces the speed and duplex setting of the out-of-band management Ethernet interface. Over the air throughput will be capped to the rate of the Ethernet interface at the receiving end of the link. Use the same setting for both ends of the link. **⚠ CAUTION** The same configuration must be forced on connected network equipment, otherwise a duplex mismatch will occur and data throughput will be greatly reduced.
Management Port Auto Mdix	This enables/disables the Auto Medium Dependent Interface (MDI)/Medium Dependent Interface Crossover (MDIX) capability. Default is 'Enabled'.
Management Port Wireless Down Alert	When enabled, this causes the out-of-band management Ethernet link to be dropped briefly when the wireless link drops. This signals to the connected network equipment that this link is no longer available. Connected Ethernet switches can be configured to forward Ethernet frames on an alternate path identified using the Spanning Tree Protocol (STP).

Table 102 Data port attributes

Attribute	Meaning
Data Port Auto Negotiation	'Enabled' means that configuration of the data Ethernet interface is automatically negotiated. This is the default setting. 'Disabled' means that configuration is forced. Use the same setting for both ends of the link.

Attribute	Meaning
Data Port Auto Neg Advertisement	Only displayed when Data Port Auto Negotiation is set to 'Enabled'. Select the data rate that the auto-negotiation mechanism will advertise as available on the the data Ethernet interface. Use the same setting for both ends of the link. Only select a data rate that is within the capability of connected network equipment, otherwise loss of service may occur. The new setting will only take effect after a system reboot.
Data Port Forced Configuration	Only displayed when Data Port Auto Negotiation is set to 'Disabled'. This forces the speed and duplex setting of the data Ethernet interface. Over the air throughput will be capped to the rate of the Ethernet interface at the receiving end of the link. Use the same setting for both ends of the link. **⚠ CAUTION** The same configuration must be forced on connected network equipment, otherwise a duplex mismatch will occur and data throughput will be greatly reduced.
Data Port Auto Mdix	This enables/disables the Auto Medium Dependent Interface (MDI)/Medium Dependent Interface Crossover (MDIX) capability. Default is 'Enabled'.
Data Port Wireless Down Alert	When enabled, this causes the data Ethernet link to be dropped briefly when the wireless link drops. This signals to the connected network equipment that this link is no longer available. Connected Ethernet switches can be configured to forward Ethernet frames on an alternate path identified using the Spanning Tree Protocol (STP).

Table 103 Bridging attributes

Attribute	Meaning
Local Packet Filtering	If Local Packet Filtering is enabled, the management agent learns the location of end stations from the source addresses in received management frames. The agent filters transmitted management frames to ensure that the frame is transmitted at the Ethernet (data or management) port, or over the wireless link as appropriate. If the end station address is unknown, then management traffic is transmitted at the Ethernet port and over the wireless link. In out-of-band local management mode, management frames are not transmitted over the wireless link, and so address learning is not active.

Reconnecting to the management PC

If Management Mode has been set to ‘Out-of-Band Local’ or ‘Out-of-Band’, connect the PTP 600 to the local management PC via the OOBM interface (the AUX port of the ODU).

If the IP Address, Subnet Mask and Gateway IP Address of the unit have been updated to meet network requirements, then reconfigure the local management PC to use an IP address that is valid for the network. Refer to Configuring the management PC on page 6-3.

When the unit has rebooted, log in using the new IP address. Refer to Logging into the web interface on page 6-5.

Task 3: Installing license keys

This task consists of the following procedures:

- Checking licensed capabilities on page 6-14
- Generating a new license key on page 6-15
- Entering a new license key on page 6-16

Some PTP 600 products are supplied with two license keys: one installed at the factory and one alternative key.

Checking licensed capabilities

To check that the capabilities of the installed license key meet the operator's requirements, select menu option **System, License Key.** The Software License Key page is displayed (Figure 107). Check the attributes in the Capability summary section (Table 104). These attributes (other than MAC Address) must be the same at both link ends, otherwise the link will not operate correctly. If the current capabilities (of the default and alternative license keys) do not meet the operator's requirements, then determine the new requirements and perform Generating a new license key on page 6-15.

Figure 107 Software License Key page

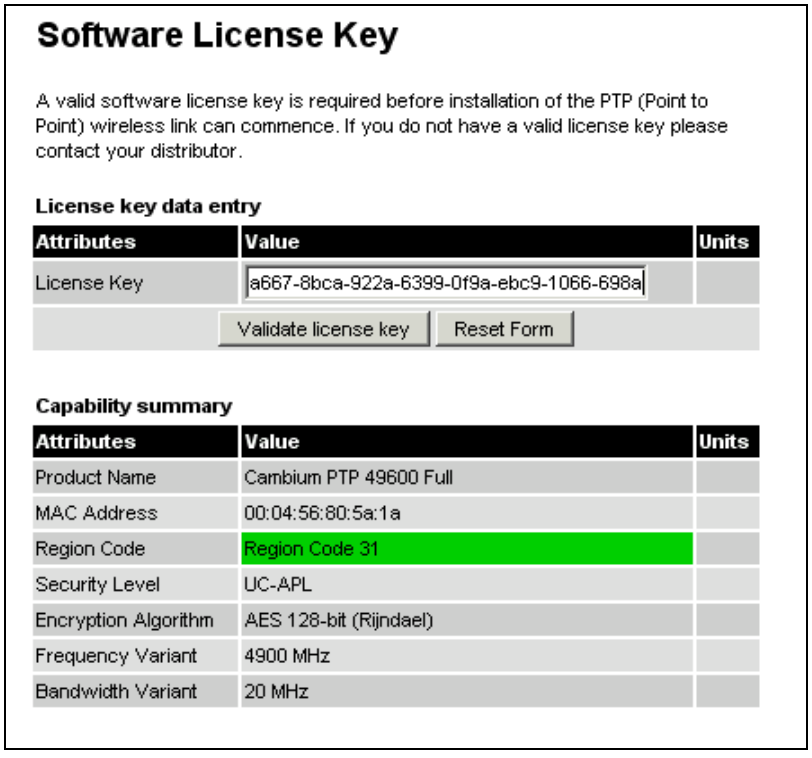


Table 104 Capability summary attributes

Attribute	Meaning
Product Name	The name of the PTP 600 product variant.
MAC Address	The MAC address of the PTP 600.
Region Code	The region code prohibits the wireless unit from operating outside the regulated limits. An invalid region code indicates a corrupted license key.
Security Level	The maximum configurable security level. If FIPS 140-2 capability is required, ensure that the Security Level is set to 'FIPS'. If UC APL capability is required, ensure that the Security Level is set to 'UC-APL'.
Encryption Algorithm	The encryption algorithms available for use at the wireless interface of the ODU. Encryption algorithm and keys must be the same at BOTH ends of the link for it to function correctly. This attribute is only displayed if the current license key permits encryption.
Frequency Variant	Frequency variant of the wireless unit.
Bandwidth Variant	Bandwidth variant of the wireless unit.

Generating a new license key

To generate a new license key to activate new licensed capabilities (for example Region Code, FIPS Security Level or Encryption Algorithm), proceed as follows:

1. Purchase the required new capabilities from the Cambium authorized Point-To-Point dealer who supplied the PTP 600 link. The dealer will supply one or more access keys.
2. Go to the PTP web support website (see Contacting Cambium Networks on page 2).
3. Select **Key Generator**. The PTP License Key Generator form should be displayed.
4. Enter the required details, including the access keys supplied by the dealer.
5. Submit the web form. The PTP License Key Generator will respond with the new license key.

Entering a new license key

To upgrade the unit to a new license key, proceed as follows:

1. Select menu option **System, License Key**. The Software License Key page is displayed.
2. Enter the new License Key.
3. Select **Validate license key**. If the license key is valid, the Reboot Wireless Unit dialog is displayed:

Reboot Wireless Unit
The new license key has been accepted. The system now requires a reboot before any new features can be accessed
Reboot Wireless Unit

4. Select **Reboot Wireless Unit** and select **OK** to confirm.
5. On completion, the unit restarts with the new license key.

Task 4: Upgrading software version

This task consists of the following procedures:

- Checking the installed software version on page 6-17
- Upgrading to a new software version on page 6-18

⚠ CAUTION

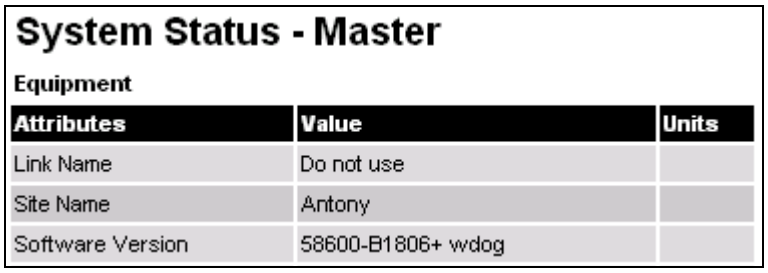
Ensure that the correct units are upgraded, as units cannot easily be downgraded afterwards.

If the link is operational, ensure that the remote end of the link is upgraded first using the wireless connection, and then the local end can be upgraded. Otherwise, the remote end may not be accessible.

Checking the installed software version

To check the installed software version, proceed as follows:

1. Select menu option **Status**. The System Status page is displayed.
2. Note the installed Software Version (near the top of the page):



System Status - Master

Equipment

Attributes	Value	Units
Link Name	Do not use	
Site Name	Antony	
Software Version	58600-B1806+ wdog	

3. If FIPS capability is required, check that the installed software is FIPS validated, as indicated by a `FIPS-` prefix to the Software Version, for example:

   `FIPS-PTP600-10-01`

4. If UC APL capability is required, check that the installed software is UC APL validated, as indicated by a `UC_APL-` prefix to the Software Version, for example:

   `UC_APL-PTP600-10-00.DLD2`

5. Go to the support website (see Contacting Cambium Networks on page 2) and find Point-to-Point software updates. Check that the latest PTP 600 software version (for example 600-10-01) is the same as the installed Software Version.
6. If the software needs to be upgraded, either to the latest version or to a FIPS or UC APL capable version, perform Upgrading to a new software version on page 6-18.

Upgrading to a new software version

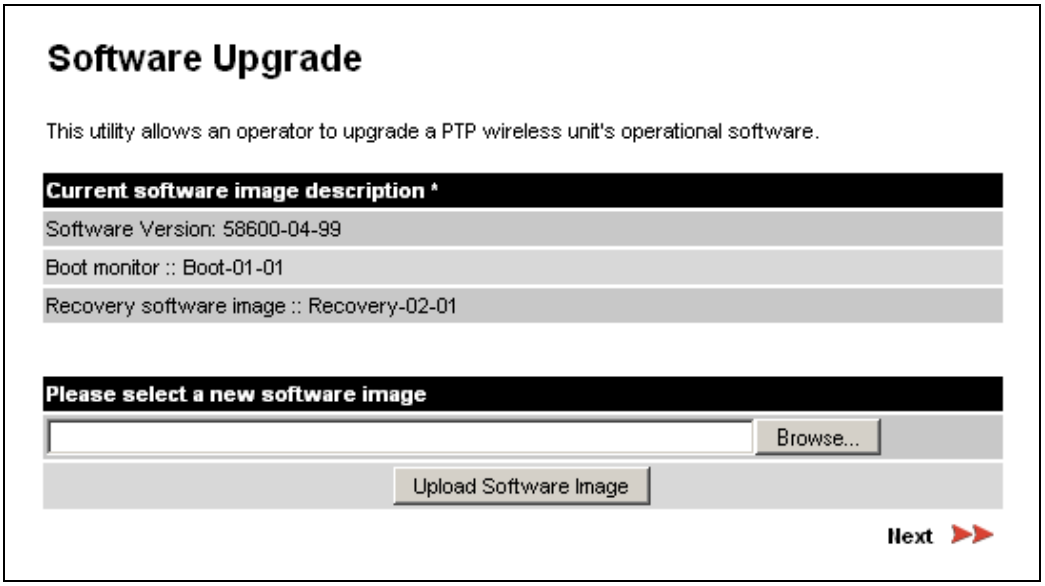
To upgrade to a new software version, proceed as follows:

1. Save the pre-upgrade system configuration as described in Saving the system configuration on page 6-110.

2. Go to the support website (see Contacting Cambium Networks on page 2) and find Point-to-Point software updates. Download and save the required software image (for example `PTP600-10-00.DLD2` or `FIPS-PTP600-10-00.DLD2` or UC_APL-PTP600-10-00.DLD2).

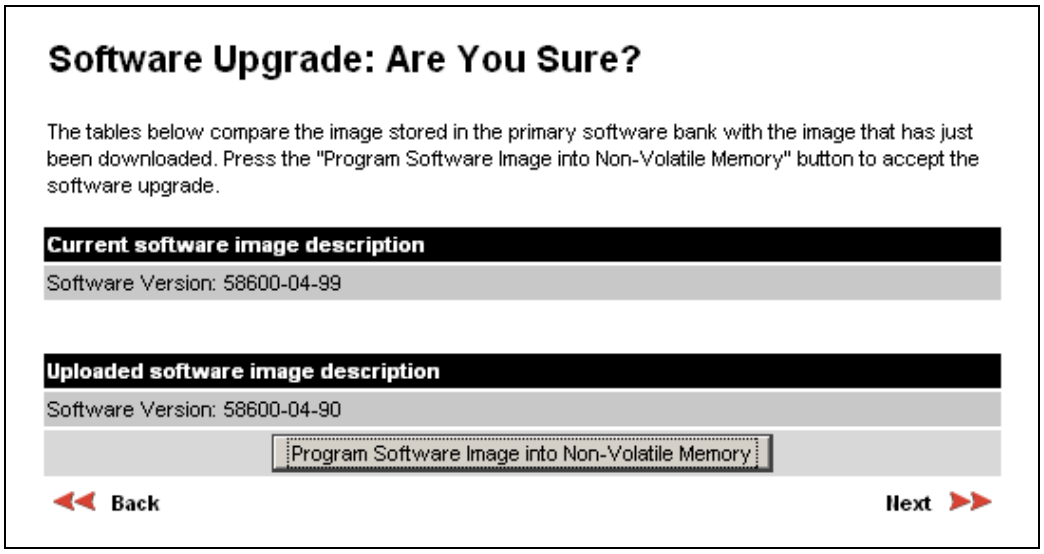
   NOTE
   The FIPS image cannot be loaded unless the Security Level capability is FIPS or UC APL. The UC APL image cannot be loaded unless the Security Level capability is UC APL.

3. Select menu option **System, Software Upgrade**. The Software Upgrade page is displayed:


Software Upgrade
This utility allows an operator to upgrade a PTP wireless unit's operational software.
Current software image description *
Software Version: 58600-04-99
Boot monitor :: Boot-01-01
Recovery software image :: Recovery-02-01
Please select a new software image
Browse...
Upload Software Image
Next

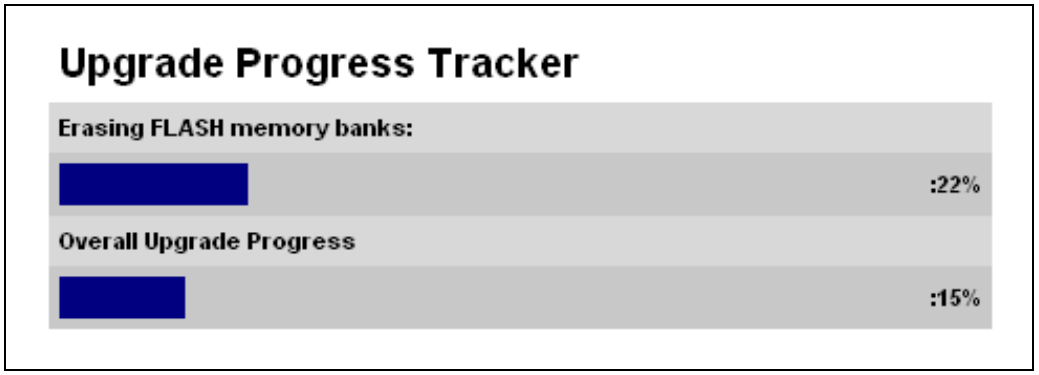
4. Select **Browse**. Navigate to the folder containing the downloaded software image and select **Open**.

5 Select **Upload Software Image**. The Software Upgrade Confirmation page is displayed:


Software Upgrade: Are You Sure?
The tables below compare the image stored in the primary software bank with the image that has just been downloaded. Press the "Program Software Image into Non-Volatile Memory" button to accept the software upgrade.
Current software image description
Software Version: 58600-04-99
Uploaded software image description
Software Version: 58600-04-90
Program Software Image into Non-Volatile Memory
Back
Next

If the upgrade is taking the ODU into or out of FIPS mode, an additional warning is displayed stating that the upgrade will cause automatic erasure of the critical security parameters (CSPs).

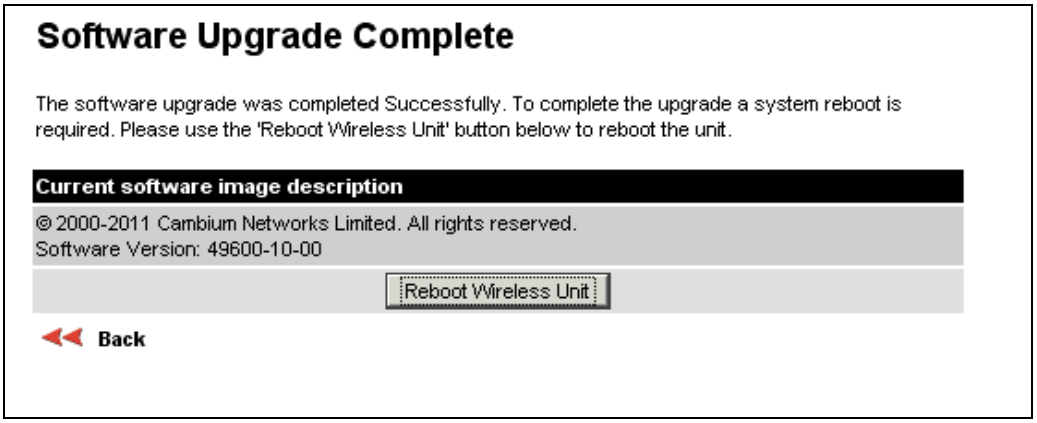
6 Select **Program Software Image into Non-Volatile Memory**. The Progress Tracker page is displayed:



⚠ CAUTION

The upgrade process should not be interrupted, as this can result in a corrupt main software image, which will result in the recovery image being booted at the next reset cycle.

7 On completion, the Software Upgrade Complete page is displayed:


Software Upgrade Complete
The software upgrade was completed Successfully. To complete the upgrade a system reboot is required. Please use the 'Reboot Wireless Unit' button below to reboot the unit.
Current software image description
© 2000-2011 Cambium Networks Limited. All rights reserved.
Software Version: 49600-10-00
Reboot Wireless Unit
Back

Select **Reboot Wireless Unit** and select **OK** to confirm. The unit begins the reboot process.

8 The reboot process will take up to 120 seconds. During this time it will not be possible to communicate with the unit. After the reboot, check that the required software image is loaded and running.

9 Save the post-upgrade system configuration as described in Saving the system configuration on page 6-110.

NOTE

If communication with the unit is not restored after 120 seconds, this could indicate a problem with the memory update process. If this happens, enter Recovery Mode as described in Using recovery mode on page 7-53.

Task 5: Configuring security

Perform this task to configure the PTP 600 in accordance with the network operator's security policy. Choose from the following procedures:

- Configuring AES encryption on page 6-22: to configure AES link encryption without HTTPS/TLS.
- Configuring HTTPS/TLS on page 6-23: to configure the unit to operate in HTTPS/TLS mode.
- Configuring local user accounts on page 6-34: to set user account options, password complexity and identity-based users.
- Changing own user password on page 6-41: for any user to change their own password.
- Protecting access to the summary and status pages on page 6-41: to apply password access to the System Summary and System Status pages.
- Configuring RADIUS authentication on page 6-42: to configure RADIUS server authentication of PTP 600 users.

NOTE

If FIPS 140-2 secure mode is required, refer to Configuring for FIPS 140-2 applications on page 6-111 instead of Configuring HTTPS/TLS on page 6-23.

NOTE

If UC APL secure mode is required, refer to Configuring for UC APL applications on page 6-114 instead of Configuring HTTPS/TLS on page 6-23.

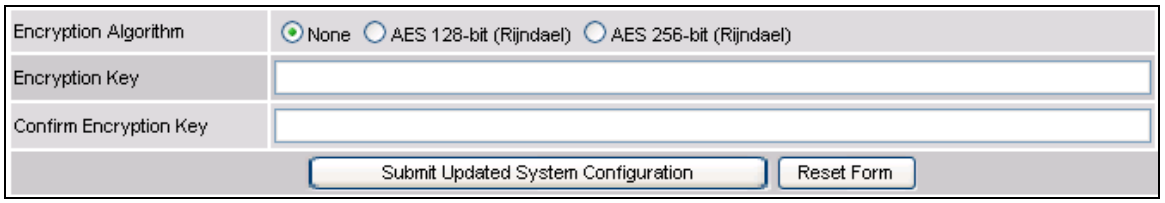
CAUTION

Ensure that the operator's security requirements are configured before connecting the PTP 600 to the network. Otherwise, security may be compromised.

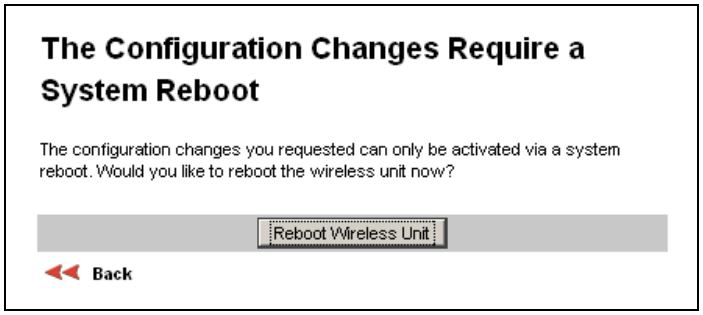
Configuring AES encryption

To configure AES link encryption (before the link is operational), proceed as follows:

1. Check the capability summary in the Software License Key page to ensure that the current license key supports AES. If necessary, obtain an access key and generate a new license key, as described in Task 3: Installing license keys on page 6-14.
2. Select menu option **System, Configuration**. The System Configuration page is displayed with encryption attributes:



3. Select the Encryption Algorithm, either ‘AES 128-bit’ or ‘AES 256-bit’. The same algorithm must be used at both ends of the link.
4. Enter and confirm the encryption key. The key consists of 32 or 64 case-insensitive hexadecimal characters. The same key must be used at both ends of the link.
5. Select **Submit Updated System Configuration**. The reboot confirmation dialog is displayed:


The Configuration Changes Require a System Reboot
The configuration changes you requested can only be activated via a system reboot. Would you like to reboot the wireless unit now?
Reboot Wireless Unit
Back

6. Select **Reboot Wireless Unit** and then **OK** to confirm.

Configuring AES encryption in an operational link

CAUTION

Configuring link encryption over an operational link will necessitate a service outage. Therefore, the configuration process should be scheduled during a period of low link utilization.

To enable AES encryption over an operational link, proceed as follows:

1. Open two browsers.
2. Log into the web interfaces at each end of the link.
3. Perform Configuring AES encryption on page 6-22 at one unit.
4. Perform Configuring AES encryption on page 6-22 at the other unit.
5. Reboot both ends of the link. The software is designed to allow five seconds so that a user can command both ends of the link to reboot before the wireless link drops.

Configuring HTTPS/TLS

Perform this procedure if the unit is required to operate in HTTPS/TLS mode. For more information, refer to Planning for HTTPS/TLS operation on page 2-41.

NOTE

If FIPS 140-2 secure mode is required, refer to Configuring for FIPS 140-2 applications on page 6-111 instead of this procedure.

If UC APL secure mode is required, refer to Configuring for UC APL applications on page 6-114 instead of this procedure.

To configure HTTPS/TLS, proceed as follows:

1. Ensure that the following cryptographic material has been generated:

   Key Of Keys

   TLS Private Key and Public Certificates (for the correct IP address)

   User Defined Security Banner

   Entropy Input

   Wireless Link Encryption Key for AES

2. Identify the Port numbers for HTTPS, HTTP and Telnet.

3 Ensure that the web browsers used are enabled for HTTPS/TLS operation.

4 Select menu option Management, Web, Local User Accounts and check that:

EITHER: Identity Based User Accounts are 'Disabled',

OR: Identity Based User Accounts are 'Enabled'. and the current user's role is Security Officer.

5 Perform Task 3: Installing license keys on page 6-14 and ensure that the installed license key meets all requirements including HTTPS/TLS compatibility:

Check that Encryption Algorithm is 'AES....'.

If necessary, generate and enter a new license key with the above settings.

6 To activate HTTPS/TLS mode, perform Using the Security Wizard on page 6-24.

Using the Security Wizard

If the PTP 600 is to operate in secure mode, use the Security Wizard to review and configure HTTPS/TLS security related parameters.

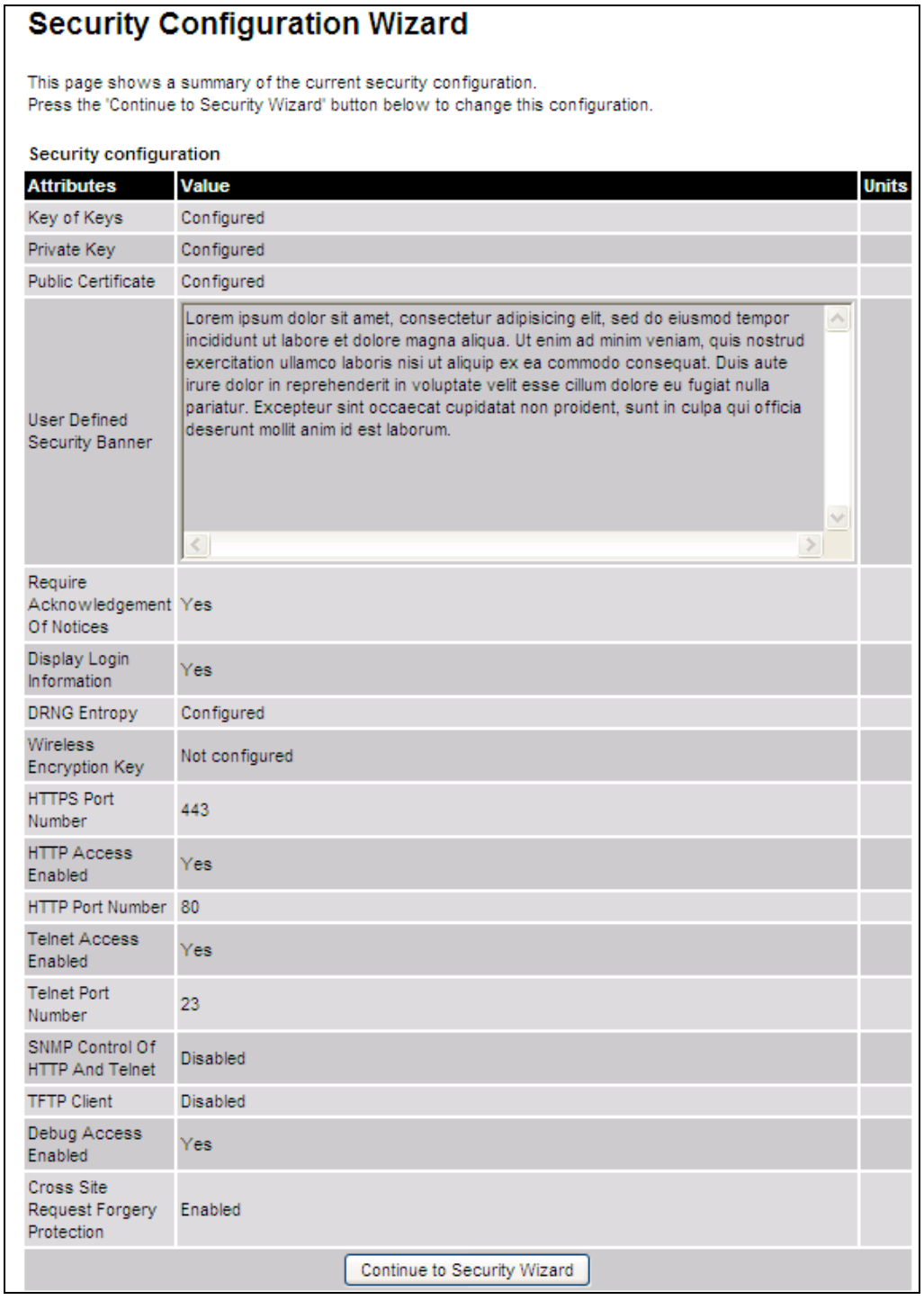
The Security Wizard is only available when both of the following conditions are true:

- The wireless unit has a license key with either 128-bit or 256-bit AES link encryption enabled,
- AND:
  - EITHER: identity-based user accounts are disabled,
  - OR: identity-based user accounts are enabled and the user's role is Security Officer.

Starting security wizard

Select menu option **Security**. The Security Configuration Wizard page is displayed (Figure 108). Review the summary. If any updates are required, select **Continue to Security Wizard**.

Figure 108 Security Configuration Wizard page



Security Configuration Wizard

This page shows a summary of the current security configuration.
Press the "Continue to Security Wizard" button below to change this configuration.

Security configuration

Attributes	Value	Units
Key of Keys	Configured	
Private Key	Configured	
Public Certificate	Configured	
User Defined Security Banner	Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.	
Require Acknowledgement Of Notices	Yes	
Display Login Information	Yes	
DRNG Entropy	Configured	
Wireless Encryption Key	Not configured	
HTTPS Port Number	443	
HTTP Access Enabled	Yes	
HTTP Port Number	80	
Telnet Access Enabled	Yes	
Telnet Port Number	23	
SNMP Control Of HTTP And Telnet	Disabled	
TFTP Client	Disabled	
Debug Access Enabled	Yes	
Cross Site Request Forgery Protection	Enabled	

Continue to Security Wizard

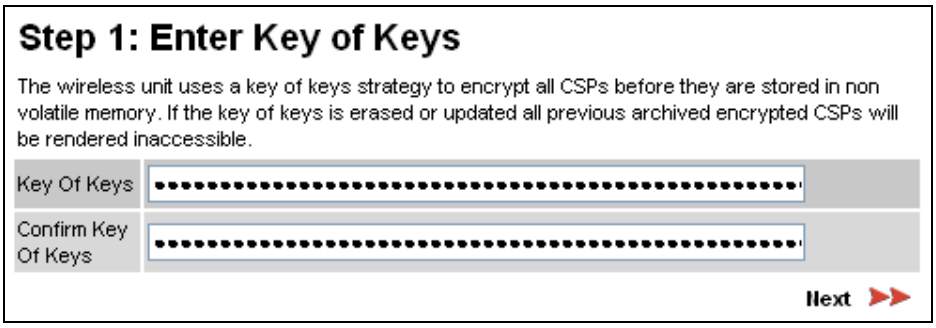
Step 1: Enter key of keys

⚠ CAUTION

Erasing or changing the key of keys erases all critical security parameters (CSPs).

The Step 1: Enter Key of Keys page is displayed (Figure 109). Enter the generated key of keys in both the Key Of Keys and Confirm Key Of Keys fields. Select **Next**.

Figure 109 Step 1: Enter Key of Keys page


Step 1: Enter Key of Keys
The wireless unit uses a key of keys strategy to encrypt all CSPs before they are stored in non volatile memory. If the key of keys is erased or updated all previous archived encrypted CSPs will be rendered inaccessible.
Key Of Keys
Confirm Key Of Keys
Next

Step 2: TLS private key and public certificate

CAUTION

If the certificates expire, the unit will be unreachable. If this occurs, put the unit into recovery mode and erase all configuration. For more information, refer to Using recovery mode on page 7-53.

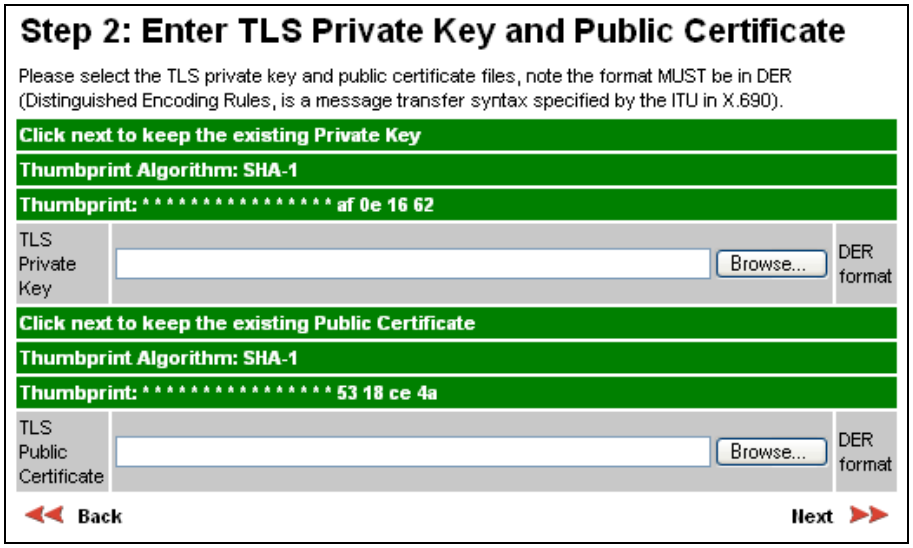
The Step 2: TLS Private Key and Public Certificate page is displayed (Figure 110).

If a valid TLS private key exists, then an SHA-1 thumbprint of the key is displayed. If this key is correct, then take no action. Otherwise, select **Browse** and select the generated private key file (.der).

If a valid TLS public certificate exists, then an SHA-1 thumbprint of the certificate is displayed. If this certificate is correct, then take no action. Otherwise, select **Browse** and select the generated certificate file (.der).

Select **Next.**

Figure 110 Step 2: TLS Private Key and Public Certificate page


Step 2: Enter TLS Private Key and Public Certificate
Please select the TLS private key and public certificate files, note the format MUST be in DER (Distinguished Encoding Rules, is a message transfer syntax specified by the ITU in X.690).
Click next to keep the existing Private Key
Thumbprint Algorithm: SHA-1
Thumbprint: * * * * * * * * * * * * * * * * af 0e 16 62
TLS Private Key
Browse...
DER format
Click next to keep the existing Public Certificate
Thumbprint Algorithm: SHA-1
Thumbprint: * * * * * * * * * * * * * * * * 53 18 ce 4a
TLS Public Certificate
Browse...
DER format
Back
Next

Step 3: User defined security banner

The Step 3: User Security Banner page is displayed (Figure 111). Update the User Defined Security Banner (optional) and set the Acknowledgement to 'No' or 'Yes'. This banner will be displayed every time a user attempts to login to the wireless unit. Select **Next**.

> **NOTE**
> For UC APL, the text reproduced in Security banner text for UC APL on page 6-117 is valid at the date of publication of this User Guide. UC APL requires Acknowledgement to be 'Yes'.

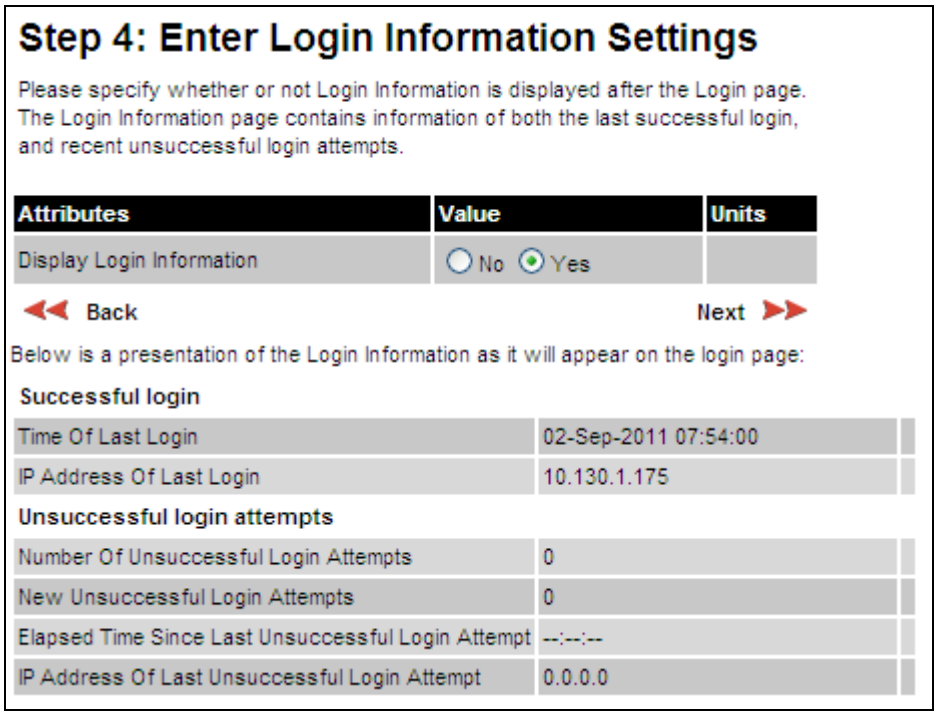
Figure 111 Step 3: User Security Banner page

Step 3: Enter User Security Banner
Please enter your organization's user security banner text.
Usage Summary
456 of 1499 characters used
User Defined Security Banner
Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.
Require Acknowledgement Of Notices
No
Yes
Back
Next
Below is a presentation of the banner as it will appear on the login page
Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.
I have read, understand and accept the above notice(s)

Step 4: Login information settings

The Step 4: Login Information Settings page is displayed (Figure 112). Set Display Login Information to 'No' or 'Yes'. Select **Next**.

Figure 112 Step 4: Login Information Settings page

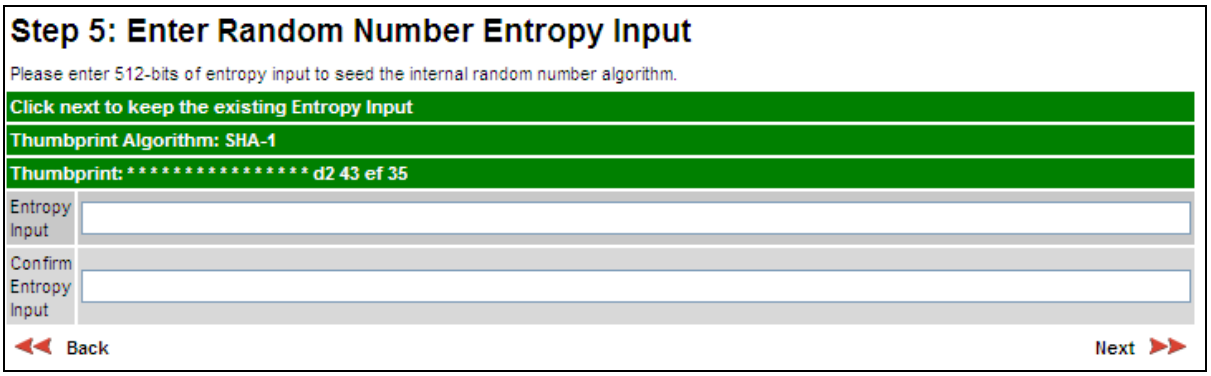

Step 4: Enter Login Information Settings
Please specify whether or not Login Information is displayed after the Login page. The Login Information page contains information of both the last successful login, and recent unsuccessful login attempts.
Attributes
Value
Units
Display Login Information
No
Yes
Back
Next
Below is a presentation of the Login Information as it will appear on the login page:
Successful login
Time Of Last Login
02-Sep-2011 07:54:00
IP Address Of Last Login
10.130.1.175
Unsuccessful login attempts
Number Of Unsuccessful Login Attempts
0
New Unsuccessful Login Attempts
0
Elapsed Time Since Last Unsuccessful Login Attempt
--:--:--
IP Address Of Last Unsuccessful Login Attempt
0.0.0.0

Step 5: Random number entropy input

The Step 5: Random Number Entropy Input page is displayed (Figure 113).

If valid entropy input exists, then an SHA-1 thumbprint of the input is displayed. If this input is correct, then take no action. Otherwise, enter the generated input in the Entropy Input and Confirm Entropy Input fields. Select **Next**.

Figure 113 Step 5: Random Number Entropy Input page

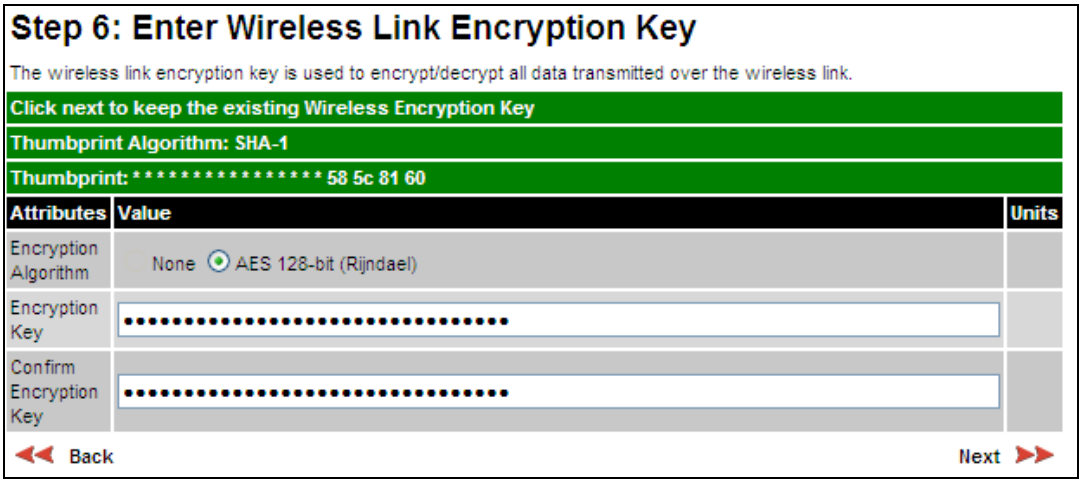

Step 5: Enter Random Number Entropy Input
Please enter 512-bits of entropy input to seed the internal random number algorithm.
Click next to keep the existing Entropy Input
Thumbprint Algorithm: SHA-1
Thumbprint: ********** d2 43 ef 35
Entropy Input
Confirm Entropy Input
Back
Next

Step 6: Enter the wireless link encryption key

The Step 6: Enter The Wireless Link Encryption Key page is displayed (Figure 114). The wireless link encryption key is used to encrypt all traffic over the PTP 600 wireless link.

Select the applicable value in the Encryption Algorithm field. If a valid encryption key exists, then an SHA-1 thumbprint of the key is displayed. If this key is correct, then take no action. Otherwise, enter the generated key in the Wireless Link Encryption Key and Confirm Wireless Link Encryption Key fields. Select **Next**.

Figure 114 Step 6: Enter Wireless Link Encryption Key page



Step 7: HTTP and Telnet settings

The Step 7: HTTP and Telnet Settings page is displayed (Figure 115). The PTP 600 can be remotely managed in four ways: HTTPS, HTTP, Telnet or SNMP. Review and update the HTTP and Telnet attributes (Table 105). Select **Next**.

> **NOTE**
> In FIPS and UC APL secure modes, the Telnet Access Enable attribute is automatically set to No, and the SNMP Control is automatically set to Disabled.

Figure 115 Step 7: HTTP and Telnet Settings page

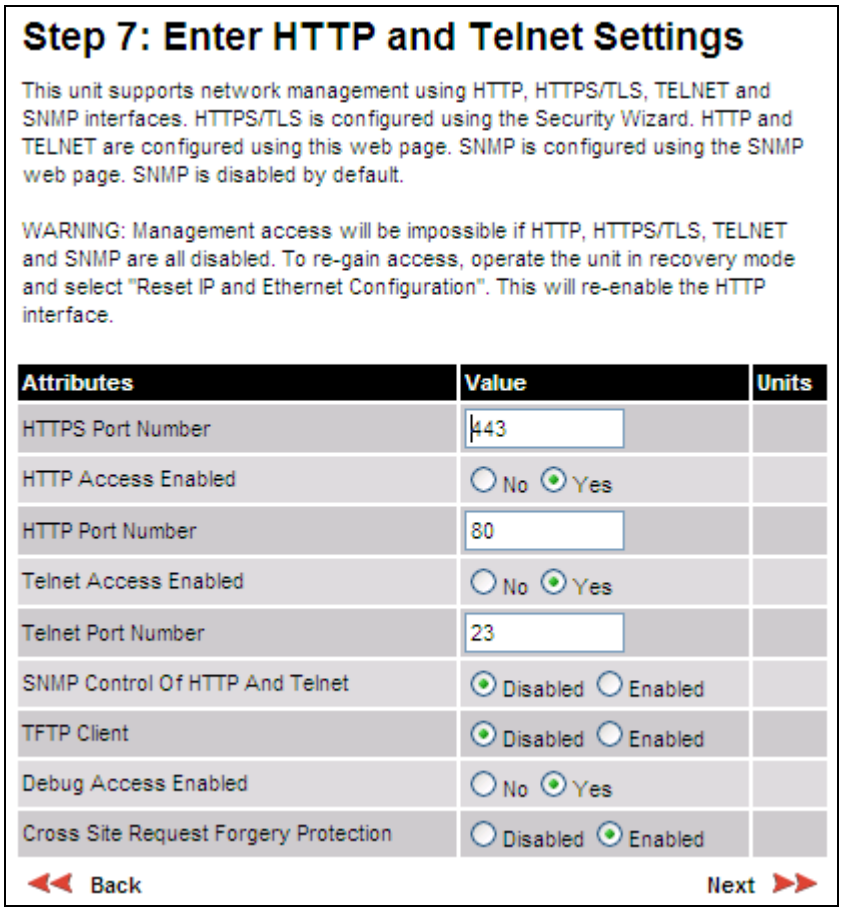

Step 7: Enter HTTP and Telnet Settings
This unit supports network management using HTTP, HTTPS/TLS, TELNET and SNMP interfaces. HTTPS/TLS is configured using the Security Wizard. HTTP and TELNET are configured using this web page. SNMP is configured using the SNMP web page. SNMP is disabled by default.
WARNING: Management access will be impossible if HTTP, HTTPS/TLS, TELNET and SNMP are all disabled. To re-gain access, operate the unit in recovery mode and select "Reset IP and Ethernet Configuration". This will re-enable the HTTP interface.
Attributes
Value
Units
HTTPS Port Number
443
HTTP Access Enabled
No
Yes
HTTP Port Number
80
Telnet Access Enabled
No
Yes
Telnet Port Number
23
SNMP Control Of HTTP And Telnet
Disabled
Enabled
TFTP Client
Disabled
Enabled
Debug Access Enabled
No
Yes
Cross Site Request Forgery Protection
Disabled
Enabled
Back
Next

Table 105 HTTP and Telnet attributes

Attribute	Meaning
HTTPS Port Number	The port number for HTTPS access. A value of zero means the wireless unit uses the default port. NOTE HTTPS access is controlled by license key.
HTTP Access Enabled	'No' means that the unit will not respond to any requests on the HTTP port. 'Yes' means that the unit will respond to requests on the HTTP port. Remote management via HTTPS is not affected by this setting.
HTTP Port Number	The port number for HTTP access. A value of zero means the wireless unit uses the default port.
Telnet Access Enabled	'No' means that the unit will not respond to any requests on the Telnet port. 'Yes' means that the unit will respond to requests on the Telnet port.
Telnet Port Number	The port number for Telnet access. A value of zero means the wireless unit uses the default port.
SNMP Control of HTTP And Telnet	'Disabled' means that neither HTTP nor Telnet can be controlled remotely via SNMP. 'Enabled' means that both HTTP and Telnet can be controlled remotely via SNMP.
TFTP Client	'Enabled' means that the unit will respond to TFTP software download requests.
Debug Access Enabled	'Yes' means that Cambium Technical Support is allowed to access the system to investigate faults.
Cross Site Request Forgery Protection	'Enabled' means that the system is protected against cross-site request forgery attacks at the web-based interface.

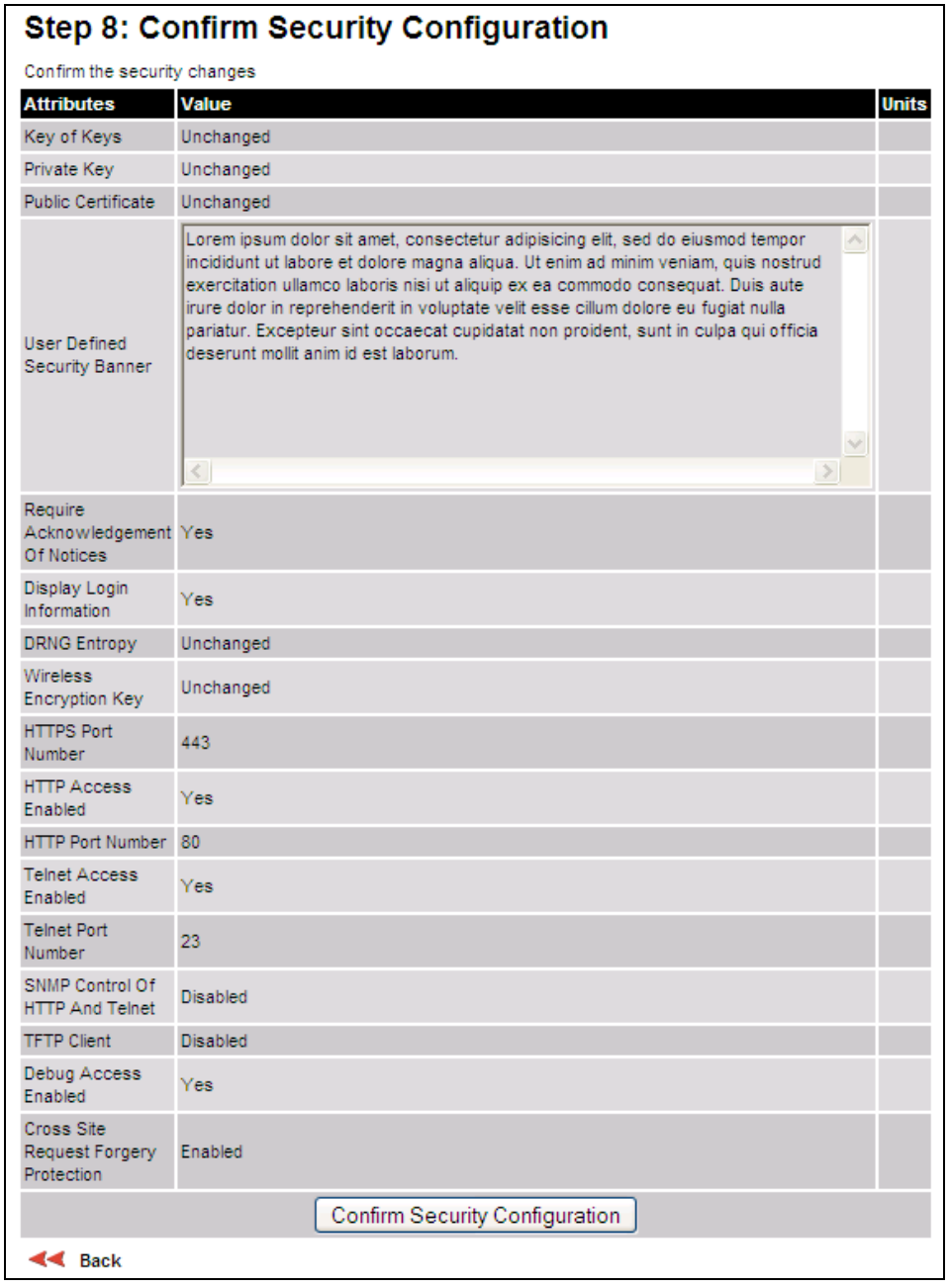
NOTE

If HTTP, Telnet and SNMP are all disabled (as required for FIPS 140-2 or UC APL mode), the secure web server becomes the only management tool for the ODU web interface. To reenter the web interface after Step 7 of the Security Wizard, use the URL **https://aa.bb.cc.dd** (where aa.bb.cc.dd is the IP address of the unit).

Step 8: Commit security configuration

Review all changes that have been made in the Security Wizard (Figure 116). To ensure that the changes take effect, select **Commit Security Configuration**. The unit reboots and the changes take effect.

Figure 116 Step 8: Commit Security Configuration page



NOTE

If the Key of keys is entered or modified in the Security Wizard, user accounts are reset when **Commit Security Configuration** is selected. It is then necessary to reconfigure them.

Configuring local user accounts

Perform this task to ensure that user access to the web-based management interface is controlled in accordance with the network operator's security policy. If identity-based user accounts are enabled, this procedure may only be performed by a Security Officer.

Setting user account options

Select menu option **Management, Web, Local User Accounts**. The User Accounts page is displayed (Figure 117). Review and update the User Account Management attributes (Table 106). If any attributes have been updated, select **Submit User Account Updates**.

Figure 117 User Accounts page (identity-based user accounts not shown)

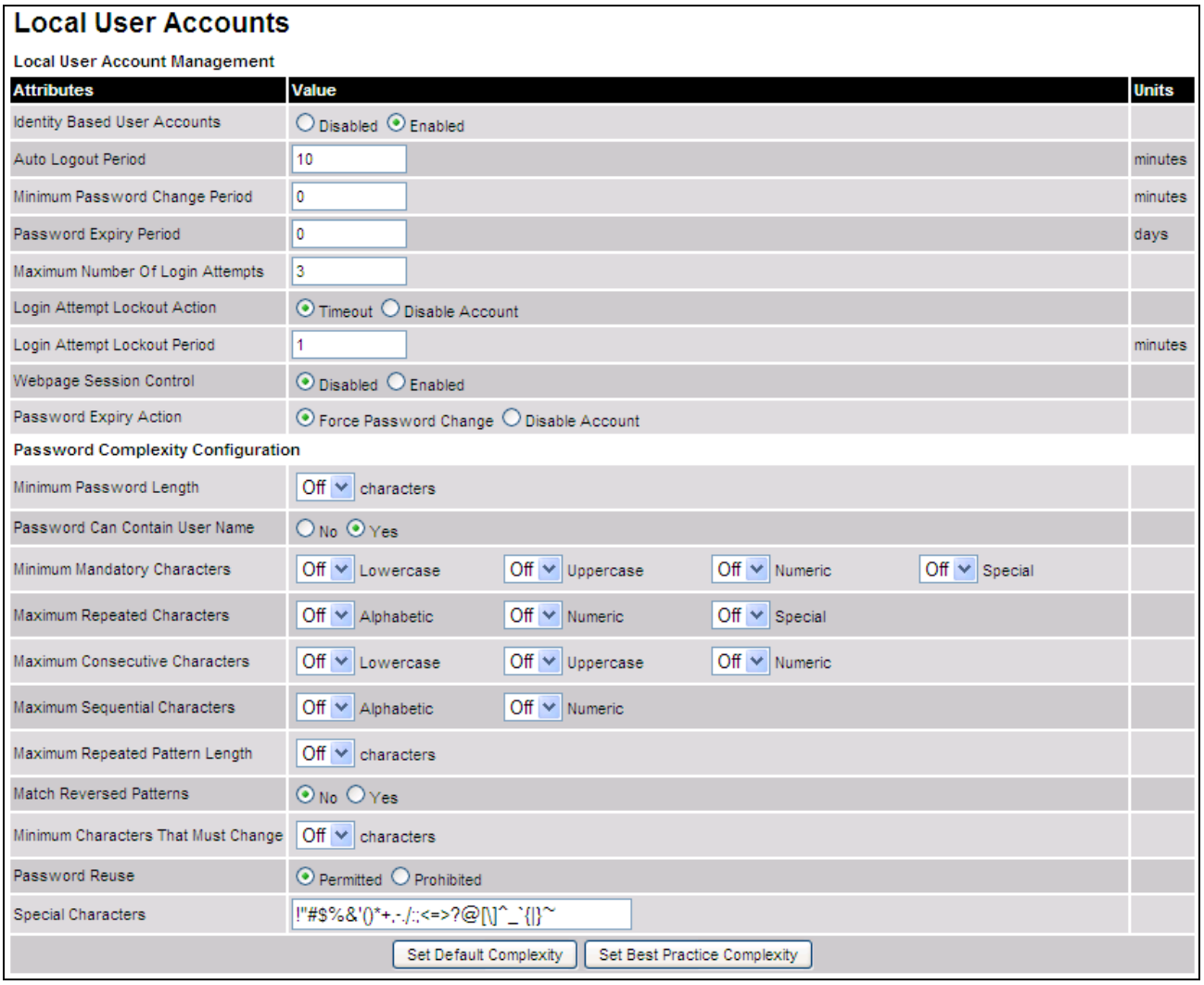


Table 106 User account management attributes

Attribute	Meaning
Identity Based User Accounts	When this is disabled, access to the web interface is controlled by a single system administration password. When this is enabled, the identity-based user account attributes are enabled. For more information, refer to Creating or updating identity-based users on page 6-39.
Auto Logout Period	The time without user activity that elapses before a user is automatically logged out (minutes).
Minimum Password Change Period	The minimum time that elapses before a user is allowed to change a password (minutes). A value of zero disables this feature.
Password Expiry Period	The time that elapses before a password expires (days). A value of zero disables this feature.
Maximum Number of Login Attempts	The maximum number of login attempts (with incorrect password) that are allowed before a user is locked out. Also, the maximum number of password change attempts before a user is locked out.
Login Attempt Lockout Action	Action to be taken when a user is locked out. 'Timeout' means the user is allowed to attempt to log in again after a specified period. 'Disabled' means the user is disabled.
Login Attempt Lockout Period	The time that elapses before a locked out user is allowed to log in again (minutes). Only displayed when Login Attempt Lockout Action is set to 'Timeout'.
Webpage Session Control	When this is enabled, any attempt to open a new tab or browser instance will force the user to re-enter password.
Password Expiry Action	The action to be taken by the PTP 600 when a password expires.

Setting password complexity

Complete this procedure to configure password complexity rules for the web-based management interface. If identity-based user accounts are enabled, this task may only be performed by a Security Officer.

> **NOTE**
> If the unit is required to operate in FIPS 140-2 secure mode, password complexity configuration must be set to 'Best Practise Values'.

To set these options, proceed as follows:

1. Select menu option **Management, Web, Local User Accounts**. The User Accounts page is displayed (Figure 117).
2. Review and update the password complexity configuration attributes (Table 107).
3. To reset all attributes to the best practice values (as shown in Table 107), select **Set Best Practice values**. This is required for FIPS 140-2.
4. To return to default values, select **Set Default Complexity.**
5. If any attributes have been updated, select **Submit User Account Updates**.

Table 107 Password complexity configuration attributes

Attribute	Meaning	Best practice
Minimum Password Length	The minimum number of characters required in passwords.	10
Password Can Contain User Name	'No' means that passwords must not contain the user name. 'Yes' means that passwords may contain the user name.	No
Minimum Mandatory Characters	The minimum number of lowercase, uppercase, numeric and special characters required in passwords. For example, if all values are set to 2, then 'FredBloggs' will be rejected, but 'FredBloggs(25)' will be accepted.	2

Attribute	Meaning	Best practice
Maximum Repeated Characters	The maximum number of consecutive repeated alphabetic, numeric and special characters permitted in passwords. For example, if all values are set to 2, then ‘aaa’, ‘XXX’, ‘999’ and ‘$$$’ will be rejected, but ‘aa’, ‘XX’, ‘99’ or ‘$$’ will be accepted.	2
Maximum Consecutive Characters	The maximum number of consecutive lowercase, uppercase and numeric characters permitted in passwords. For example, if all values are set to 5, then ‘ALFRED’, ‘neuman’ and ‘834030’ will be rejected.	5
Maximum Sequential Characters	The maximum number of alphabetic and numeric characters permitted in passwords. For example, if set to 3, then ‘abcd’, ‘WXYZ’ and ‘0123’ will be rejected, but ‘abc’, ‘xyz’ and ‘123’ will be accepted.	3
Maximum Repeated Pattern Length	The maximum sequence of characters that can be repeated consecutively in passwords. For example, if set to 3, then ‘BlahBlah’ and ‘31st31st’ will be rejected, but ‘TicTicTock’ and ‘GeeGee’ will be accepted. ‘Blah-Blah’ will be accepted because the two sequences are not consecutive.	3
Match Reversed Patterns	‘No’ means that reversed patterns are not checked. ‘Yes’ means that reversed patterns are checked. For example, if Maximum Repeated Pattern Length is set to 3 and Match Reversed Patterns is set to ‘Yes’, then ‘AB1221BA’ will be rejected.	Yes
Minimum Characters That Must Change	The minimum number of password characters that must change every time a password is updated.	4
Password Reuse	‘Permitted’ means that a user may reuse a previous password. ‘Prohibited’ means that a user must not reuse a previous password.	Prohibited

Attribute	Meaning	Best practice
Special Characters	User defined set of special characters used in password construction. The only characters permitted in a password are: (a-z), (A-Z), (0-9) and any of the special characters entered here.	!"%&'()*+,-./:;<=>?

Creating or updating identity-based users

Perform this procedure to allow multiple users (from one to ten) to access the ODU with different levels of access. There are three defined levels of access: Security Officer, System Administrator and Read Only.

If identity-based user accounts are already enabled, this task may only be performed by a user with role set to Security Officer.

To create or update identity-based user accounts, select menu option **Management, Web, Local User Accounts**. The User Accounts page is displayed (Figure 117). Set the Identity Based User Accounts attribute to 'Enabled' (if it is not already set). The identity-based user account attributes are enabled for update (Figure 118). Create or update up to 10 user accounts (Table 108) and select **Submit User Account Updates**.

Figure 118 Identity-based user accounts

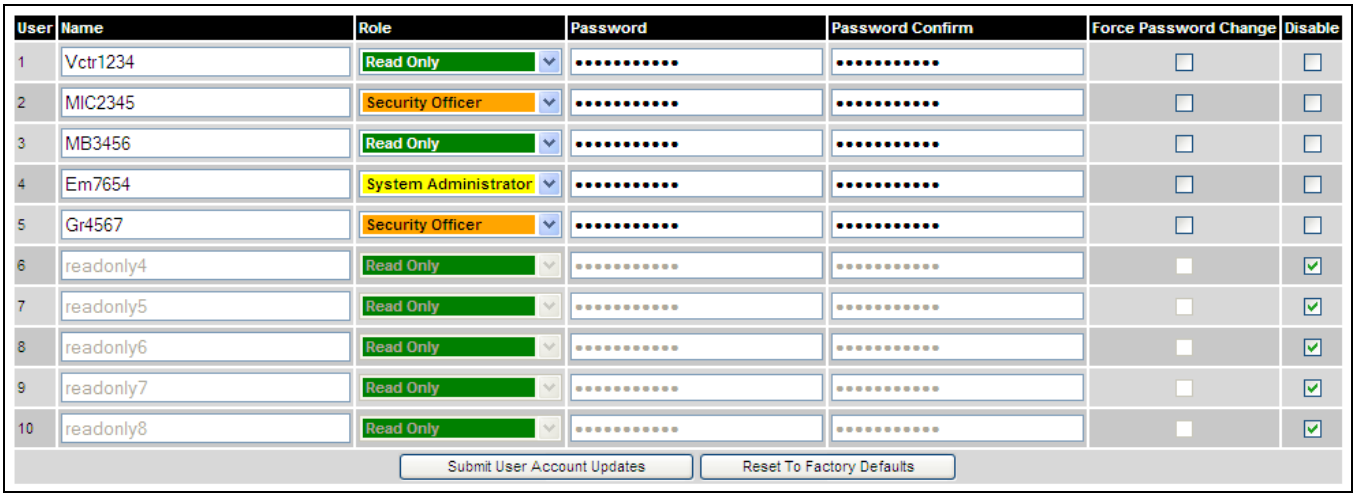


Table 108 Identity-based user accounts attributes

Attribute	Meaning
Name	Enter a user name.
Role	Select a role from the list: Security Officer System Administrator Read Only **NOTE** At least one user must be assigned the Security Officer role. If RADIUS is enabled, then this rule is relaxed, in which case the RADIUS server(s) SHOULD be configured with at least one user with 'Security Officer' privileges.
Password	Enter a password for the user. Passwords must comply with the complexity rules (Table 107).
Password Confirm	Retype the password to confirm.
Force Password Change	Force this user to change their password when they next log on.
Disable	Tick the box to disable a user account.

Enforcing password changes

To force a user to change their password when they next log in as a Security Officer, select menu option **Management, Web, Local User Accounts**, and tick that user's Force Password Change box (Figure 118).

Changing own user password

This method is used for any user to change their own password.

> **NOTE**
> A security officer can change the passwords of other users using the User Accounts page, as described in Creating or updating identity-based users on page 6-39.

Select menu option **Change Password**. The Change Password page is displayed (Figure 119). Enter and confirm the new password (the factory default is blank). The new password must comply with the complexity rules (Table 107).

Figure 119 Change Password page (System Administration example)

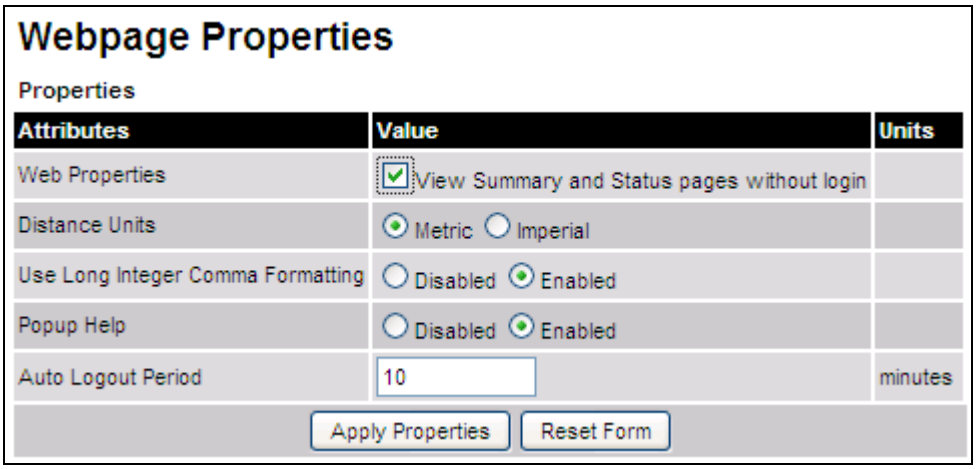
Protecting access to the summary and status pages

By default, the Home and Status menu items are not protected by password. If a higher level of system security is required, password protection can be extended to these pages.

Select menu option **Management, Web, Web Properties**. The Webpage Properties page is displayed (Figure 120). In the Web Properties attribute, uncheck the 'View Summary and Status pages without login' box, then select **Apply Properties**.

> **NOTE**
> If the System Administration Password has not yet been set, see Changing own user password on page 6-41.

Figure 120 Webpage Properties page



Configuring RADIUS authentication

This procedure is only performed when the PTP 600 unit requires RADIUS authentication.

RADIUS authentication is only available when PTP 600 is configured for Identity-based User Accounts and when RADIUS servers are connected to the network.

Only users with 'Security Officer' role are permitted to configure RADIUS authentication.

NOTE

When RADIUS is enabled, the Security Officer may disable all local user accounts, as described in Creating or updating identity-based users on page 6-39.

NOTE

At least one user with Security Officer privileges must exist and be enabled, in order to disable the RADIUS client.

Select menu option **Management, Web, Radius Configuration**. The RADIUS Configuration page is displayed (Figure 121). Update the attributes as required (Table 109). Select **Submit RADIUS Configuration**.

Figure 121 RADIUS Configuration page

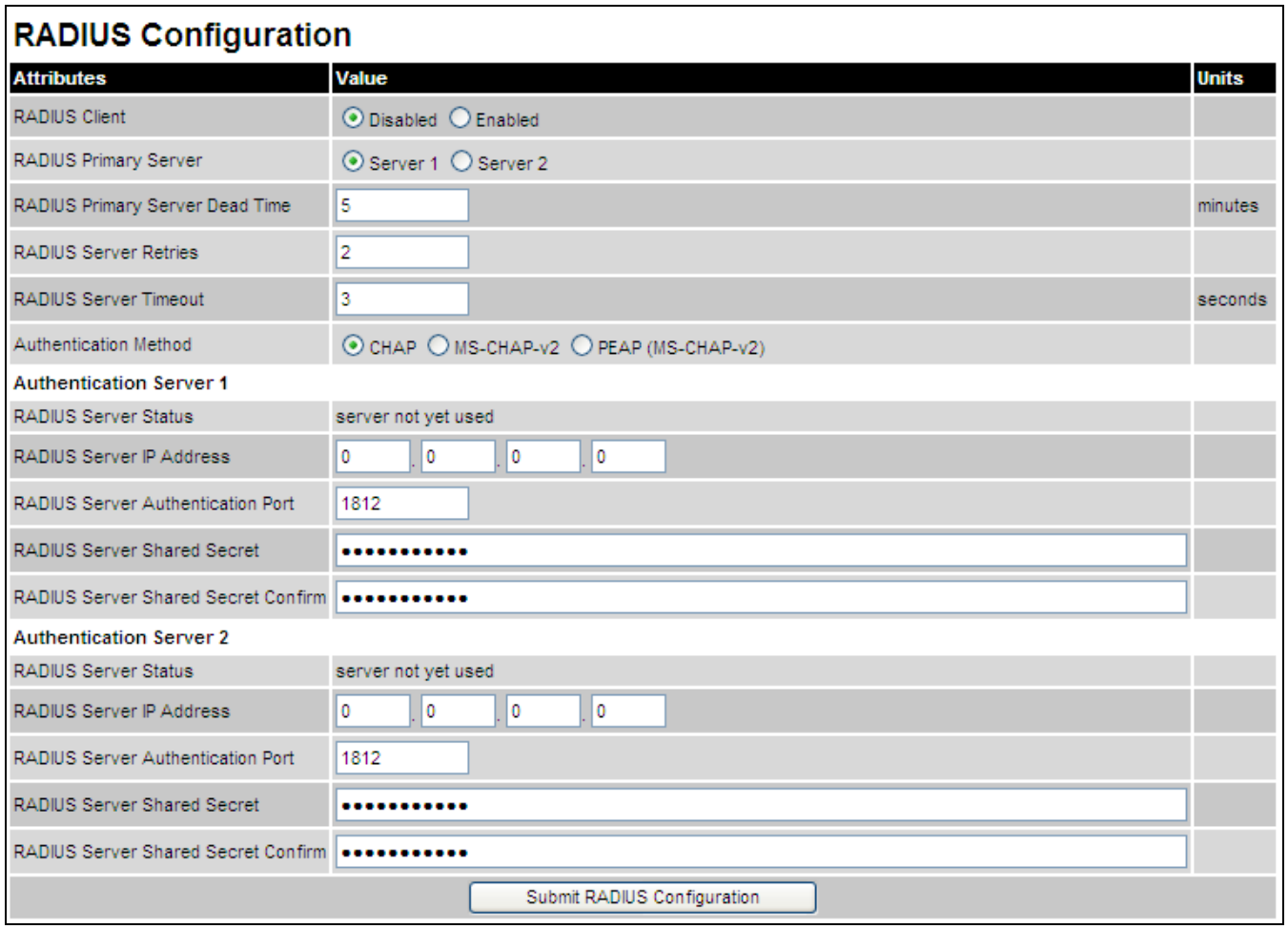


Table 109 RADIUS Authentication attributes

Attribute	Meaning
RADIUS Client Enabled	'Enabled' means that PTP 600 users may be authenticated via the RADIUS servers. 'Disabled' may only be selected if at least one user with Security Officer privileges exists.
RADIUS Primary Server	Specifies the primary server, determining the order in which the servers are tried.
RADIUS Primary Server Dead Time	Time (in minutes) to hold off trying to communicate with a previously unavailable RADIUS server. Setting the value to zero disables the timer.
RADIUS Server Retries	Number of times the PTP 600 will retry after a RADIUS server fails to respond to an initial request.
RADIUS Server Timeout	Time (in seconds) the PTP 600 will wait for a response from a RADIUS server.
Authentication Method	Method used by RADIUS to authenticate users. PEAP(MS-CHAPv2) provides a secure tunnel using TLS and is approved for FIPS 140-2.
Authentication Server 1 and 2:	
RADIUS Server Status	The status of the RADIUS server. This contains the time of the last test and an indication of success or failure. If the Authentication Server attributes are incorrect, the displayed status is 'server config not valid'.
RADIUS Server IP Address	IP address of the RADIUS server.
RADIUS Server Authentication Port	Network port used by RADIUS server for authentication services.
RADIUS Server Shared Secret	Shared secret used in RADIUS server communications. May contain alphabetic, numeric, special characters or spaces, but not extended unicode characters. The maximum length is 127 characters.
RADIUS Server Shared Secret Confirm	Shared secret confirmation.

Task 6: Configuring wireless and telecoms interfaces

The wireless and telecoms interfaces are configured using the installation wizard. The installation wizard may also be used to re-configure the Ethernet interface if required.

The installation wizard consists of the following procedures:

- Starting installation wizard on page 6-45
- Step 1: Interface configuration on page 6-48
- Step 2: Wireless configuration on page 6-51
- Step 3: TDD synchronization (optional) on page 6-58
- Step 3 or 4: Confirm installation configuration on page 6-60

For units operating within the FCC, certain channels may need to be barred from operation, as described in Barring channels on page 6-62.

Starting installation wizard

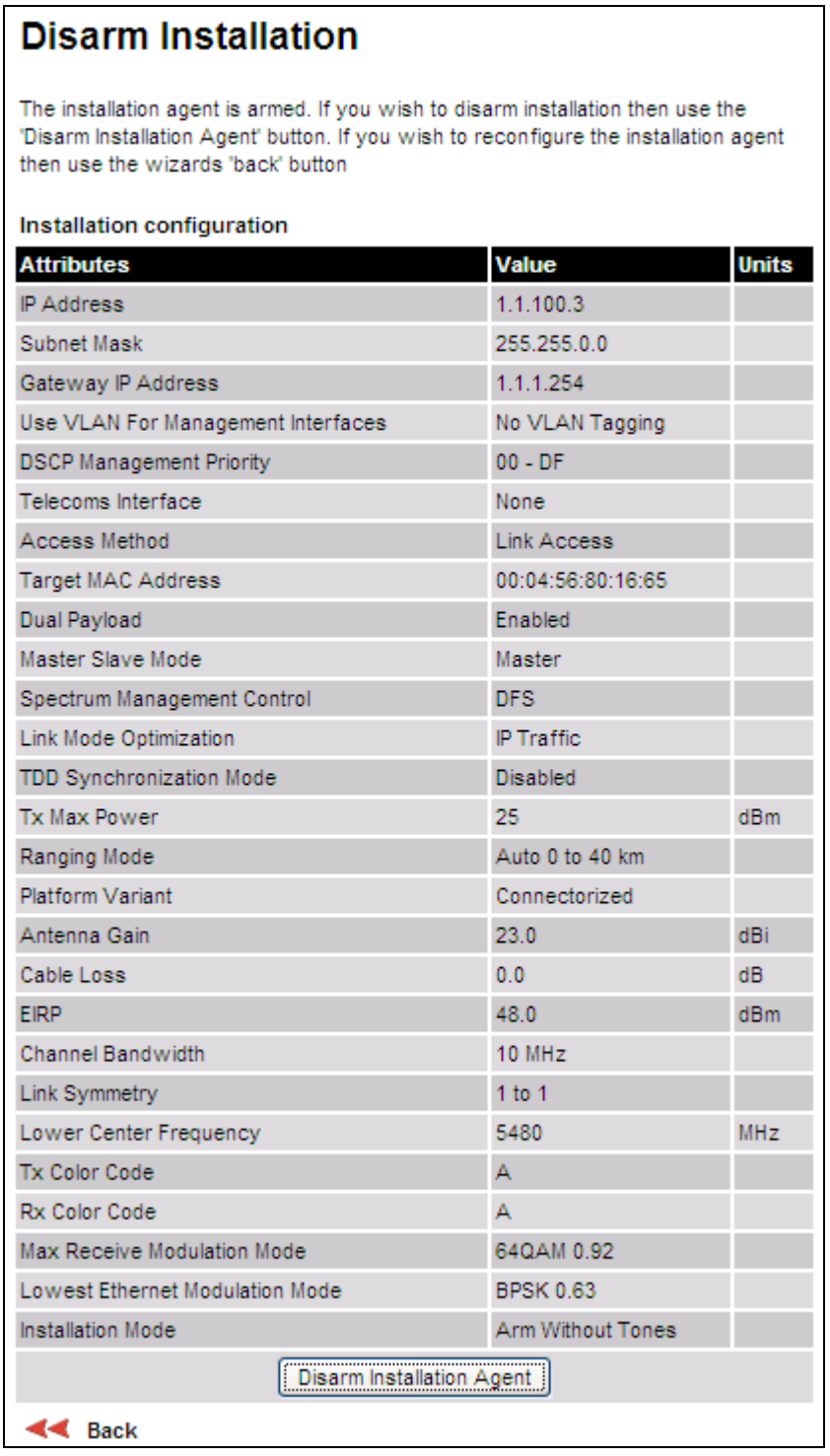
To check that the wireless configuration meets network requirements, select menu option **Installation**. The response depends upon the state of the unit:

- If the unit is armed for alignment (factory default configuration), the Disarm Installation page is displayed (Figure 122).
- If the unit is not armed, the Current Installation Summary page (Figure 123) is displayed.

Review the configuration:

- If it already meets requirements, skip this task.
- If it does not meet requirements, execute the installation wizard by one of the following methods:
  - From the Disarm Installation page (Figure 122), select **Back**.
  - From the Current Installation Summary page (Figure 123), select **Continue to Installlation Wizard**.

Figure 122 Disarm Installation page (when unit is armed)



Disarm Installation

The installation agent is armed. If you wish to disarm installation then use the 'Disarm Installation Agent' button. If you wish to reconfigure the installation agent then use the wizards 'back' button

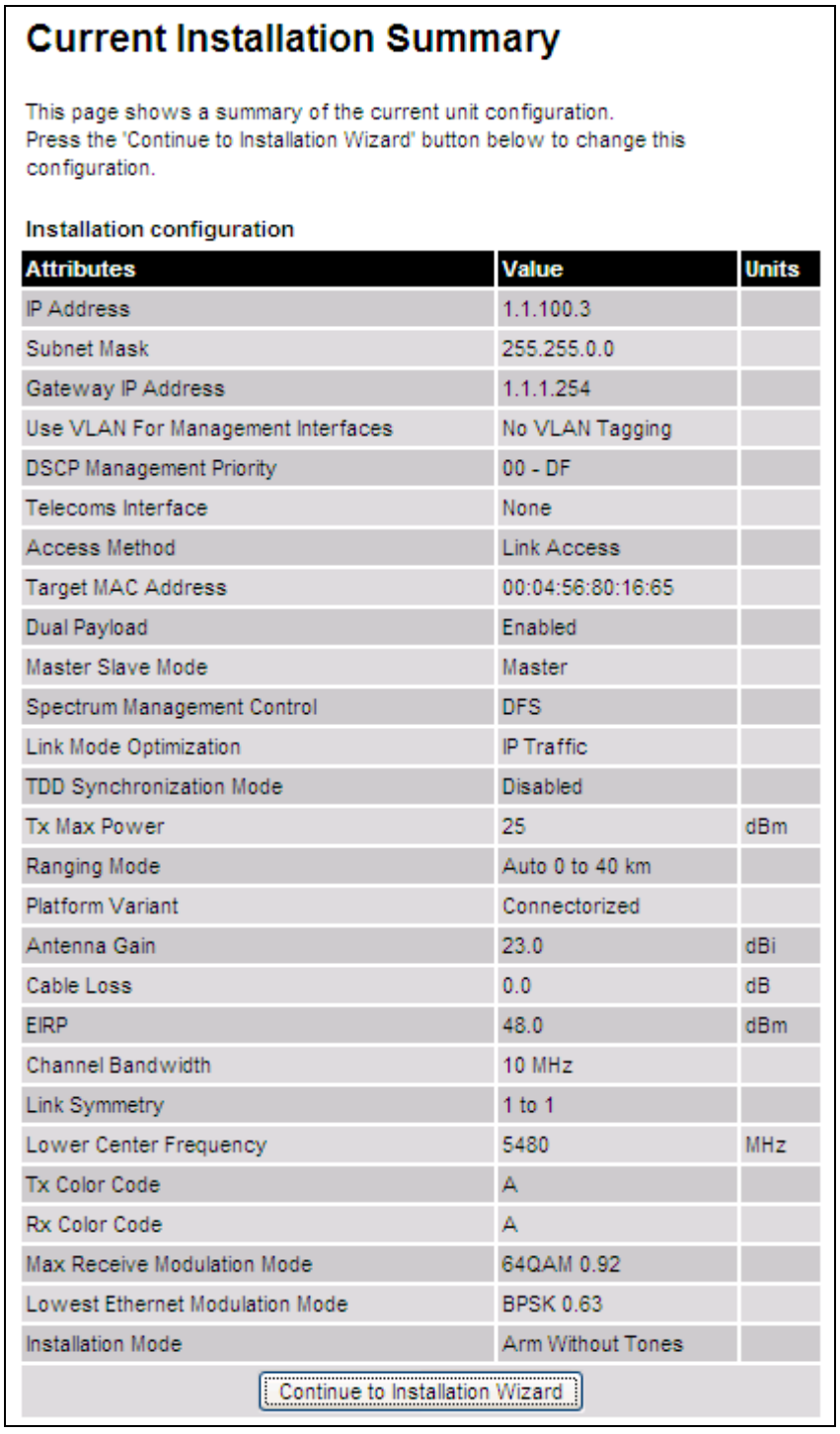
Installation configuration

Attributes	Value	Units
IP Address	1.1.100.3	
Subnet Mask	255.255.0.0	
Gateway IP Address	1.1.1.254	
Use VLAN For Management Interfaces	No VLAN Tagging	
DSCP Management Priority	00 - DF	
Telecoms Interface	None	
Access Method	Link Access	
Target MAC Address	00:04:56:80:16:65	
Dual Payload	Enabled	
Master Slave Mode	Master	
Spectrum Management Control	DFS	
Link Mode Optimization	IP Traffic	
TDD Synchronization Mode	Disabled	
Tx Max Power	25	dBm
Ranging Mode	Auto 0 to 40 km	
Platform Variant	Connectorized	
Antenna Gain	23.0	dBi
Cable Loss	0.0	dB
EIRP	48.0	dBm
Channel Bandwidth	10 MHz	
Link Symmetry	1 to 1	
Lower Center Frequency	5480	MHz
Tx Color Code	A	
Rx Color Code	A	
Max Receive Modulation Mode	64QAM 0.92	
Lowest Ethernet Modulation Mode	BPSK 0.63	
Installation Mode	Arm Without Tones	

Disarm Installation Agent

Back

Figure 123 Current installation summary page



Current Installation Summary

This page shows a summary of the current unit configuration.
Press the 'Continue to Installation Wizard' button below to change this configuration.

Installation configuration

Attributes	Value	Units
IP Address	1.1.100.3	
Subnet Mask	255.255.0.0	
Gateway IP Address	1.1.1.254	
Use VLAN For Management Interfaces	No VLAN Tagging	
DSCP Management Priority	00 - DF	
Telecoms Interface	None	
Access Method	Link Access	
Target MAC Address	00:04:56:80:16:65	
Dual Payload	Enabled	
Master Slave Mode	Master	
Spectrum Management Control	DFS	
Link Mode Optimization	IP Traffic	
TDD Synchronization Mode	Disabled	
Tx Max Power	25	dBm
Ranging Mode	Auto 0 to 40 km	
Platform Variant	Connectorized	
Antenna Gain	23.0	dBi
Cable Loss	0.0	dB
EIRP	48.0	dBm
Channel Bandwidth	10 MHz	
Link Symmetry	1 to 1	
Lower Center Frequency	5480	MHz
Tx Color Code	A	
Rx Color Code	A	
Max Receive Modulation Mode	64QAM 0.92	
Lowest Ethernet Modulation Mode	BPSK 0.63	
Installation Mode	Arm Without Tones	

Continue to Installation Wizard

Step 1: Interface configuration

Step 1 of the Installation wizard is for updating the interface configuration (Figure 124 or Figure 125). The attributes are described in Table 110. Update the attributes as required and select **Next**.

> **NOTE**
> If a copper loopback is used to test the E1 or T1 link (if enabled), ensure that the test set is configured manually. If the test set is allowed to configure automatically, neither it nor the ODU send a signal until they receive one, so the test appears to fail.

Figure 124 Step 1: Interface Configuration page

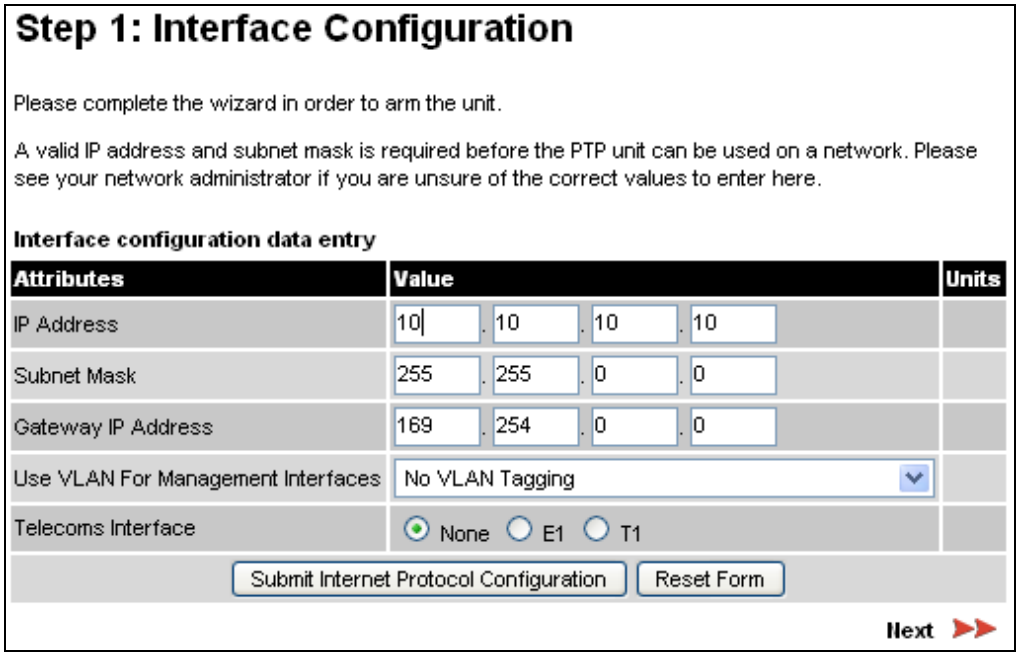

Step 1: Interface Configuration
Please complete the wizard in order to arm the unit.
A valid IP address and subnet mask is required before the PTP unit can be used on a network. Please see your network administrator if you are unsure of the correct values to enter here.
Interface configuration data entry
Attributes
Value
Units
IP Address
10 . 10 . 10 . 10
Subnet Mask
255 . 255 . 0 . 0
Gateway IP Address
169 . 254 . 0 . 0
Use VLAN For Management Interfaces
No VLAN Tagging
Telecoms Interface
None E1 T1
Submit Internet Protocol Configuration
Reset Form
Next

Figure 125 Step 1: Interface Configuration page with T1 enabled

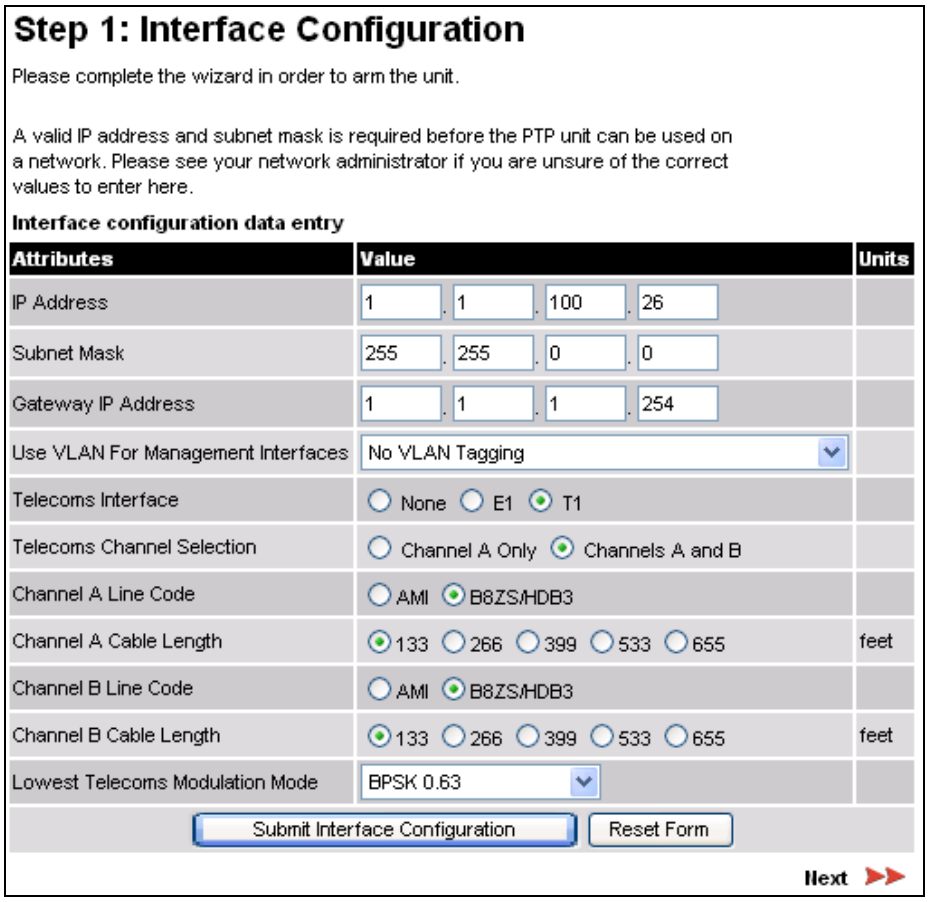

Step 1: Interface Configuration
Please complete the wizard in order to arm the unit.
A valid IP address and subnet mask is required before the PTP unit can be used on a network. Please see your network administrator if you are unsure of the correct values to enter here.
Interface configuration data entry
Attributes
Value
Units
IP Address
1 . 1 . 100 . 26
Subnet Mask
255 . 255 . 0 . 0
Gateway IP Address
1 . 1 . 1 . 254
Use VLAN For Management Interfaces
No VLAN Tagging
Telecoms Interface
None E1 T1
Telecoms Channel Selection
Channel A Only Channels A and B
Channel A Line Code
AMI B8ZS/HDB3
Channel A Cable Length
133 266 399 533 655
feet
Channel B Line Code
AMI B8ZS/HDB3
Channel B Cable Length
133 266 399 533 655
feet
Lowest Telecoms Modulation Mode
BPSK 0.63
Submit Interface Configuration
Reset Form
Next

Table 110 Step 1: Interface Configuration standard attributes

Attribute	Meaning
IP Address	Updated in Configuring the IP interface and management mode on page 6-7.
Subnet Mask	Updated in Configuring the IP interface and management mode on page 6-7.
Gateway IP Address	Updated in Configuring the IP interface and management mode on page 6-7.
Use VLAN For Management Interfaces	Updated in Configuring the IP interface and management mode on page 6-7.
VLAN Management VID	Only displayed when Use VLAN for Management Interfaces is enabled. Updated in Configuring the IP interface and management mode on page 6-7.

Attribute	Meaning
VLAN Management Priority	Only displayed when Use VLAN for Management Interfaces is enabled. Updated in Configuring the IP interface and management mode on page 6-7.
Management Mode	Only displayed when Use VLAN for Management Interfaces is enabled. Updated in Configuring the IP interface and management mode on page 6-7.
Telecoms Interface	This allows the activation of the telecoms interface. The selection options are None, E1 or T1.
Telecoms Channel Selection	Only displayed when Telecoms Interface is set to 'E1' or 'T1' (Figure 125). The PTP 600 can support one or two telecoms channels ('Channel A only' or 'Channels A and B').
Channel A Line Code	Only displayed when 'E1' or 'T1' are selected (Figure 125). Must match the setting of the device connected to channel A.
Channel A Cable Length	Only displayed when 'T1' is selected (Figure 125). The length of the cable connecting the ODU to the channel A transceiver.
Channel B Line Code	Only displayed when 'E1' or 'T1' are selected with 'Channels A and B' (Figure 125). Must match the setting of the device connected to channel B.
Channel B Cable Length	Only displayed when 'T1' is selected with 'Channels A and B' (Figure 125). The length of the cable connecting the ODU to the channel B transceiver.
Lowest Telecoms Modulation Mode	The modulation mode at which telecoms data can be sent. If the link cannot sustain telecoms data in this mode then the effective lowest modulation mode may differ. In conjunction with the PTP LINKPlanner tool, this setting may be used to optimize the latency for links which operate in consistently high modulation modes. High data rate links are able to support lower latencies. The effective lowest modulation mode is displayed on the Telecoms page.

Step 2: Wireless configuration

Step 2 of the Installation wizard is for updating the wireless configuration. Figure 126 shows a typical example of the Wireless Configuration page. The actual contents of the page vary depending upon frequency variant, region code and the options selected. The attributes are described in Table 111.

Update the attributes as required and select **Next**.

Figure 126 Step 2: Wireless Configuration page (example)

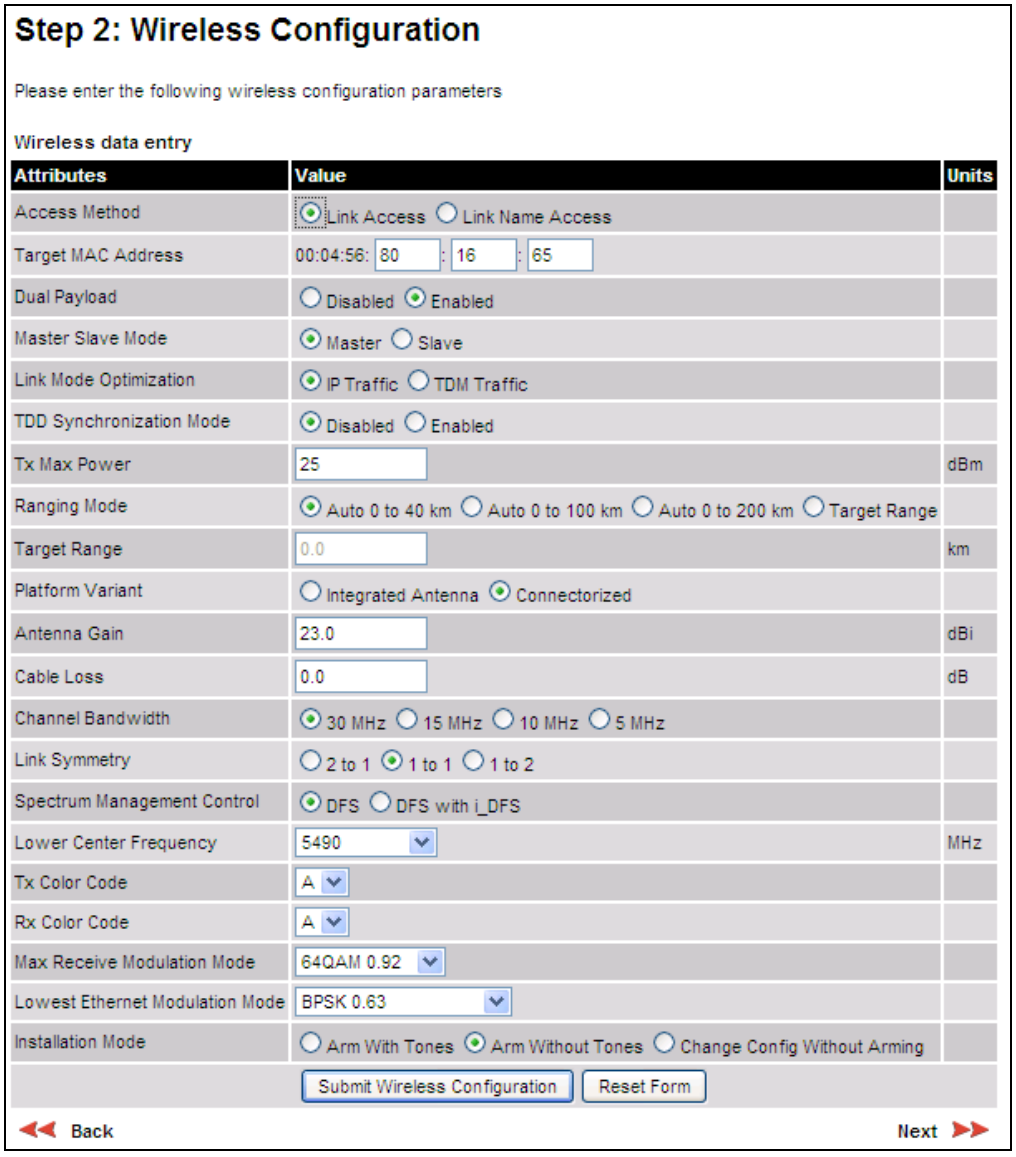


Table 111 Step 2: Wireless Configuration attributes

Attribute	Meaning
Access Method	'Link Access' means that the link is established between a pre-paired Master and Slave. 'Link Name Access' means that a link can only be established between units that have identical Link Name attributes. 'Group Access' means that a link can only be established between units that have identical Group ID attributes.
Link Name	Only displayed when Access Method is set to 'Link Name Access'. A link can only be established between units that have identical Link Names. Link Name may consist of letters (A-Z and a-z), numbers (0-9), spaces, and the following special characters: (),-.,:<=>[]_{}
Group ID	Only displayed when Access Method is set to 'Group Access'. A link can only be established between units that have identical Group IDs.
Target MAC Address	This is only displayed when Access Method is set to 'Link Access'. This is the MAC Address of the peer unit that will be at the other end of the wireless link. This is used by the system to ensure the unit establishes a wireless link to the correct peer. The MAC Address can be found embedded within the serial number of the unit. The last six characters of the serial number are the last three bytes of the unit's MAC address. **NOTE** A PTP 600 Series system is shipped as a pair of units with pre-loaded correct MAC addresses. Target MAC addresses will only need to be entered if an existing unit has to be replaced in the field, or the unit configuration has been erased.
Dual Payload	This controls whether the link takes advantage of the channel condition to increase the link throughput. If set to 'Disable', the robustness of the link is improved. The default value is 'Enabled'. This control is automatically set to 'Enabled' if either E1 or T1 is enabled and Lowest Telecoms Modulation Mode is set to a Dual Payload modulation.

Attribute	Meaning
Master Slave Mode	At this point it is necessary to decide which end will designate a Master. The Master unit is the controlling unit with respect to the point-to-point link and its maintenance. The master transmits until the link is made, while the Slave listens for its peer and only transmits when the peer has been identified.
Link Mode Optimization	Optimizes the link behavior according to the type of traffic that will be bridged. There are two modes to choose from: IP and TDM. For more information, see Link mode optimization on page 1-27.
TDD Synchronization Mode	Enables the TDD synchronization feature. See TDD synchronization on page 1-34 for basic description and Step 3: TDD synchronization (optional) on page 6-58 for installation and configuration details.
Encryption Algorithm	This is only displayed when encryption is enabled by license key. The same algorithm must be used at both ends of the link. Updated in Task 5: Configuring security on page 6-21.
Encryption Key	This is only displayed when encryption is enabled by license key. The same key must be used at both ends of the link. When identity based user accounts are enabled, only the Security Officer can change the encryption key. Updated in Task 5: Configuring security on page 6-21.
Confirm Encryption Key	This is only displayed when encryption is enabled by license key. Must contain the same value as Encryption Key.
Tx Max Power	This is the maximum transmit power (dBm) at which the unit will transmit. Set this to the value (dBm) for antenna alignment as recommended in the installation report. **NOTE** For short line of sight links, PTP LINKPlanner may recommend a lower value for alignment than for normal operation.

Attribute	Meaning
Ranging Mode	During installation, the wireless units perform “Automatic Ranging”. The ranging mode allows the installer to control the behavior of the system’s automatic ranging algorithms. The default value is 0 to 40 km (0 to 25 miles). If the installer is required to install a link of greater than 40 km (25 miles) then the ranging mode attribute MUST be configured to ‘0 to 100km’ (0 to 62 miles) or ‘0 to 200km’ (0 to 124 miles) mode depending on the range of the link. **NOTE** If preferred, range functions can be configured to operate in miles, as described in Protecting access to the summary and status pages on page 6-41.
Target Range	Installers that know the range between the two wireless units to within ± 1 km can use the target range mode. The main advantage of the target range mode is that it reduces the time taken by the units to range. To use the target range mode the installer MUST select Target Range as the ranging mode and enter the approximate range in km in the Target range data entry field at both ends of the link.
Platform Variant	Chooses either an integrated unit, or a connectorized unit that requires an external antenna.
Antenna Gain	Only displayed when Platform Variant is set to ‘Connectorized’. Gain of the antenna that is connected to the unit.
Cable Loss	Only displayed when Platform Variant is set to ‘Connectorized’. Loss in the cable between the ODU and the antenna. **NOTE** If there is a significant difference in length of the antenna cables for the two antenna ports, then the average value should be entered.
Frequency Band	Only displayed for the PTP 25600 frequency variant, which operates in one of three bands as described in Channel bandwidth on page 2-4: Lower: 2496 MHz to 2568 MHz Middle: 2572 MHz to 2614 MHz Upper: 2624 MHz to 2690 MHz

Attribute	Meaning
Channel Bandwidth	Users can choose a variable channel bandwidth for the available spectrum. The choice of bandwidths depends upon the frequency variant and region, as shown in Table 1.
Link Symmetry	(Master only) Values of "Adaptive", "2 to 1", "1 to 1" and "1 to 2" can be selected. The adaptive setting allows link symmetry to vary dynamically in response to offered traffic load. The remaining values select three options for fixed division between transmit and receive time in the TDD frame of the master ODU. The first number in the ratio represents the time allowed for the transmit direction and the second number represents the time allowed for the receive direction. The appropriate matching Link Symmetry is set at the slave ODU automatically. For example, if Link Symmetry is configured as '2 to 1' at the master ODU, then the slave ODU will be set automatically as '1 to 2'. In this example, the master-slave direction has double the capacity of the slave-master direction. Link Symmetry is subject to the following restrictions: 'Adaptive' is not supported in regions where radar avoidance is in use. 'Adaptive' is not supported when link optimization is set to 'TDM'. 'Adaptive' is not supported in 5 MHz channel bandwidth. '2 to 1' and '1 to 2' are not supported in 5 MHz channel bandwidth. '2 to 1' and '1 to 2' are not supported when E1/T1 services are enabled.
Spectrum Management Control	Is used to configure the PTP 600 Series Spectrum Management features, see Managing spectrum on page 7-20 for more details. In regions that do not mandate DFS (Radar Detection), the Spectrum Management Control options are 'i-DFS' and 'Fixed Frequency'. In regions that mandate DFS (Radar Detection), the Spectrum Management Control options are 'DFS' and 'DFS with i-DFS'. The Spectrum Management Control is disabled if the regulatory requirement is fixed frequency only.

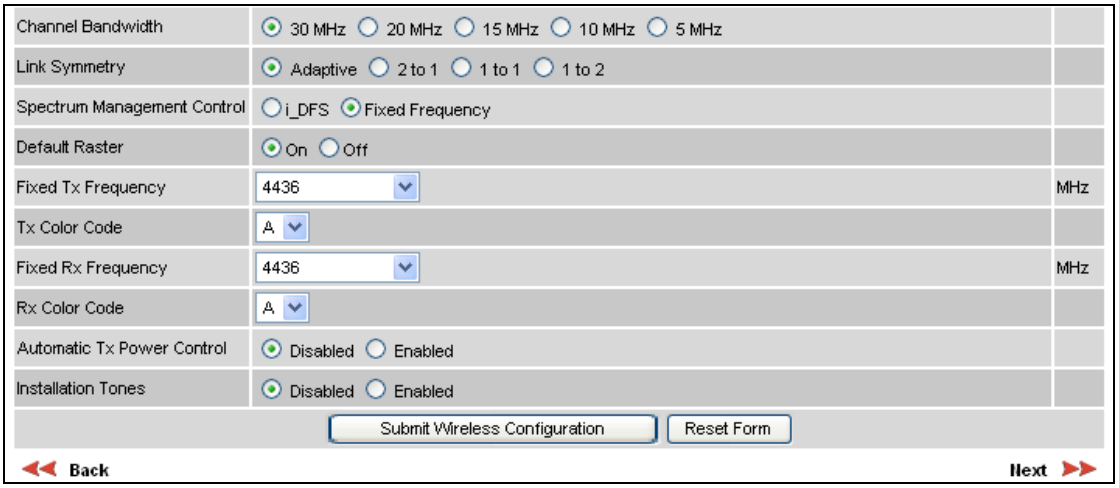
Attribute	Meaning
Lower Center Frequency	The centre frequency (MHz) of the lowest channel that may be used by this link. Not displayed when Spectrum Management Control is set to 'Fixed Frequency'. Use this attribute to slide the available channels up and down the band. To observe the effect this will have on spectrum usage, see Available spectrum settings on page 4-11. **NOTE** Because the 4.9 GHz spectrum is restricted by license, the Lower Center Frequency attribute is not available for the PTP 49600. **CAUTION** The lower center frequency attribute must be configured to the same value for both the master and slave, otherwise the wireless link will fail to reestablish. The only way to recover from this situation is to modify the Lower Center Frequency attributes so that they are identical on both the master and slave units.
Default Raster	This is only displayed when Spectrum Management Control is set to 'Fixed Frequency'. If this is set to 'On', the list of options presented in the fixed Tx frequency box is limited by the default raster.
Fixed Tx Frequency, Fixed Rx Frequency	This is only displayed when Spectrum Management Control is set to 'Fixed Frequency'. The software for the PTP 600 Series allows a user to optionally fix the Transmit and the Receive frequencies for a wireless link. The settings must be compatible at each end of the link. Once configured, the spectrum management software will not attempt to move the wireless link to a channel with lower co-channel or adjacent channel interference. Therefore this mode of operation is only recommended for deployments where the installer has a good understanding of the prevailing interference environment. See Fixed frequency example on page 6-58. **NOTE** A raster limits the selection of the Rx frequency based upon the setting of the Tx frequency.

Attribute	Meaning
Tx Color Code, Rx Color Code	The Tx Color Code and Rx Color Code attributes need only be considered when the unit is installed in a dense network of synchronized PTP 600 units and where some of the PTP 600 units are operating on the same frequency. In this case, the value would normally be derived by a network radio planner. In all other cases, it is strongly recommended that this attribute is left at the default value of 'A'. **NOTE** The value of Tx Color Code MUST always match the value of Rx Color Code at the other end of the link.
Automatic Tx Power Control	Automatic Transmit Power Control (ATPC) availability is frequency variant dependent. When available, its default setting is 'Enabled'. If Master Slave Mode has been set to 'Slave', the additional option 'Enabled with ITPE' is available. When selected, the unit calculates its transmit power prior to enabling its transmitter in order to minimize the interference caused to other user in the band.
Max Receive Modulation Mode	The maximum mode the unit will use as its adaptive modulation. By default the Max Receive Modulation Mode is the highest mode available. For minimum error rates, set the maximum modulation mode to the minimum necessary to carry the required traffic.
Lowest Ethernet Modulation Mode	The modulation mode that must be achieved before the link is allowed to bridge Ethernet frames.
Installation Mode	'Arm With Tones' means that audio tones will be emitted during antenna alignment (the recommended option). 'Arm Without Tones' means that audio tones will not be emitted during antenna alignment. 'Change Config Without Arming' means that configuration changes will be made without arming the ODU for alignment.

Fixed frequency example

Figure 127 shows an example of the fixed frequency configuration for a 30 MHz channel bandwidth. In this example, the Fixed Transmit Frequency is set to 4436 MHz and the Fixed Receive Frequency is set to 4436 MHz. Care must be taken when configuring the Fixed Transmit and Receive Frequencies to ensure that both frequencies are on the same channel raster as the Lower Center Frequency. For example, if the channel raster is 10 MHz, both the Fixed Transmit and Receive Frequencies must be a multiple of 10 MHz from the Lower Center Frequency (4426 = 4416 + 10 MHz) and (4486 = 4416 + 10 MHz × 7).

Figure 127 Step 2: Wireless Configuration page (extract) for fixed frequency



Step 3: TDD synchronization (optional)

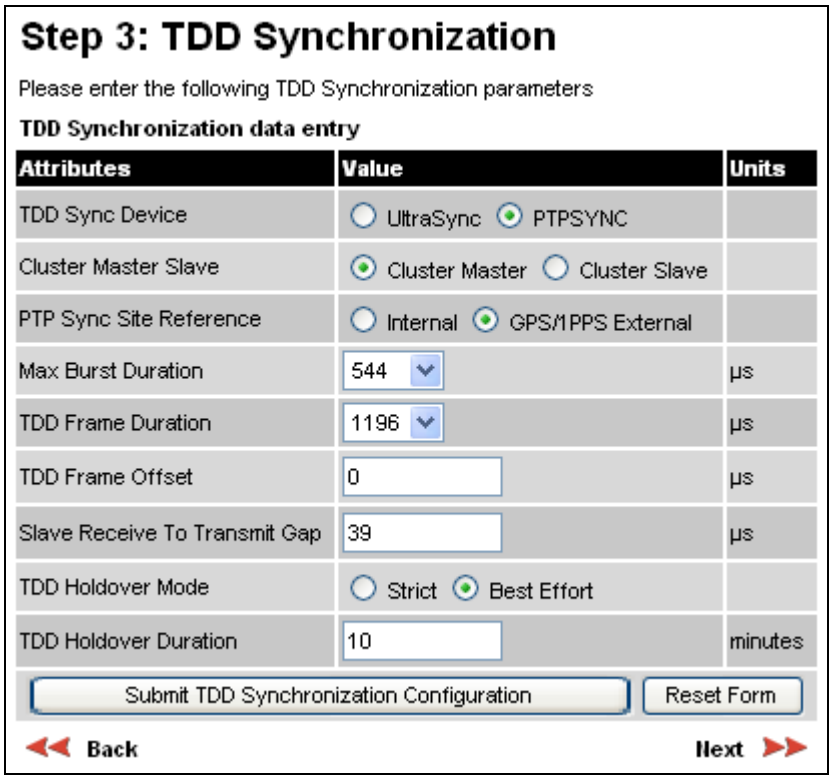
To enable TDD Synchronization, set the TDD Synchronization Mode attribute to 'Enabled' in the Step 2: Wireless Configuration page (Figure 126) and select **Next**. Step 3: TDD Synchronization page is displayed (Figure 128). The attributes are described in Table 112. Update the attributes as required and select **Next**.

For more information on the available options, refer to Configuration options for TDD synchronization on page 2-30.

When TDD Synchronization is enabled, the following restrictions apply:

- Ranging Mode and Target Range are disabled.
- Link Symmetry is forced to '1:1' operation only.

Figure 128 Step 3: TDD Synchronization page



NOTE

The data required to populate this screen is available in PTP LINKPlanner.

Table 112 Step 3: TDD Synchronization attributes

Attribute	Meaning
TDD Sync Device	Select the timing device that is to be used for TDD synchronization.
Cluster Master Slave	Only displayed when TDD Sync Device is set to 'PTPSYNC'. 'Cluster Master' is the first ODU in the synchronization chain. 'Cluster Slave' is the second or subsequent ODU in the chain.
PTP-SYNC Site Reference	Only displayed when TDD Sync Device is set to 'PTPSYNC'. 'Internal' means standalone operation with no external timing reference. 'GPS/1PPS External' means that an external GPS receiver will provide a 1 pps timing reference.
Max Burst Duration	The maximum duration of the burst opportunity. Select a value in the range 726 to 2176 microseconds.

Attribute	Meaning
TDD Frame Duration	Select a value in the range 1730 to 6410 microseconds.
TDD Frame Offset	The delay of the start of the TDD frame from the epoch of the external timing reference. This permits the design of synchronized networks in which the phase of the TDD frame is independent of the master/slave function. Enter a value in the range from zero to one microsecond less than the TDD Frame Duration.
Slave Receive To Transmit Gap	The duration of the gap between receive and transmit at the slave ODU.
TDD Holdover Mode	(Master only). 'Strict' means that the unit will not transmit when synchronization is lost. 'Best Effort' means that the unit will synchronize when there is a reference signal, but otherwise will operate in unsynchronized mode.
TDD Holdover Duration	(Master only). Default value 10 minutes, maximum 60 minutes. Specifies duration of holdover period following loss of the external timing reference for TDD synchronization.

Step 3 or 4: Confirm installation configuration

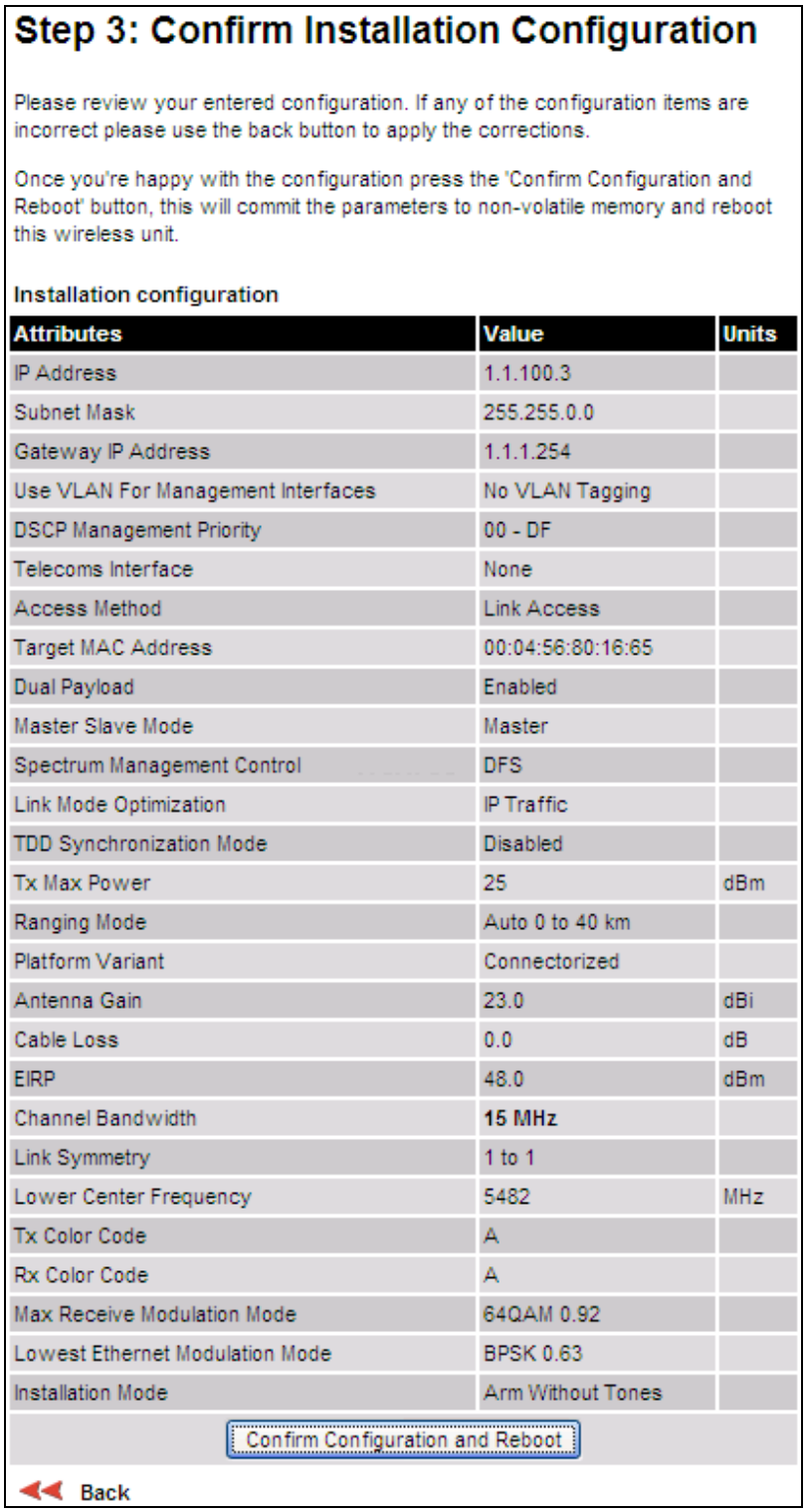
Step 3 of the Installation wizard is provided for reviewing and confirming the wireless configuration parameters (Figure 129) (this becomes Step 4 if TDD Synchronization is enabled). The page contents vary depending upon the product variant and configuration options selected.

If any of the Installation wizard attributes have been updated, select **Confirm Configuration and Reboot**. The confirmation popup is displayed (Figure 130). Select **OK** to reboot.

NOTE

If any of the interface attributes have been updated in Step 1 of the Installation wizard, the local management PC will not be able to communicate after the changes are confirmed and the reboot occurs. If it is necessary to make further configuration changes using the local management PC, modify the network configuration of the PC Ethernet port to match the new IP and VLAN configuration of the unit.

Figure 129 Step 3: Confirm Installation Configuration page



Step 3: Confirm Installation Configuration

Please review your entered configuration. If any of the configuration items are incorrect please use the back button to apply the corrections.

Once you're happy with the configuration press the 'Confirm Configuration and Reboot' button, this will commit the parameters to non-volatile memory and reboot this wireless unit.

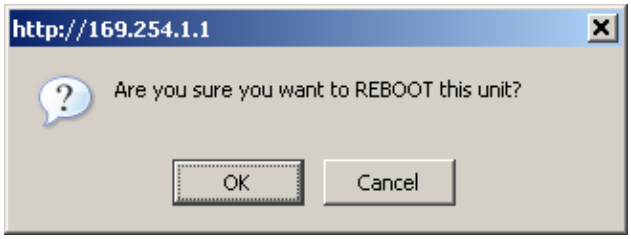
Installation configuration

Attributes	Value	Units
IP Address	1.1.100.3	
Subnet Mask	255.255.0.0	
Gateway IP Address	1.1.1.254	
Use VLAN For Management Interfaces	No VLAN Tagging	
DSCP Management Priority	00 - DF	
Telecoms Interface	None	
Access Method	Link Access	
Target MAC Address	00:04:56:80:16:65	
Dual Payload	Enabled	
Master Slave Mode	Master	
Spectrum Management Control	DFS	
Link Mode Optimization	IP Traffic	
TDD Synchronization Mode	Disabled	
Tx Max Power	25	dBm
Ranging Mode	Auto 0 to 40 km	
Platform Variant	Connectorized	
Antenna Gain	23.0	dBi
Cable Loss	0.0	dB
EIRP	48.0	dBm
Channel Bandwidth	**15 MHz**	
Link Symmetry	1 to 1	
Lower Center Frequency	5482	MHz
Tx Color Code	A	
Rx Color Code	A	
Max Receive Modulation Mode	64QAM 0.92	
Lowest Ethernet Modulation Mode	BPSK 0.63	
Installation Mode	Arm Without Tones	

Confirm Configuration and Reboot

Back

Figure 130 Reboot confirmation pop up



Barring channels

For units operating within the FCC, certain channels may need to be barred from operation.

⚠ CAUTION

To comply with FCC rules, bar any channels that may interfere with TDWR radars. This must be done before the units are allowed to radiate on site. The system designer will have provided a list of any affected channels, based on the instructions in Avoidance of weather radars (USA only) on page 2-5.

To bar channels, log into the master unit and select menu option **System, Spectrum Management**. The Spectrum Management page is displayed (Figure 167). Click on the appropriate channel center frequencies on the Local or Peer channel spectrum plots. When the confirmation dialog is displayed, select **OK**.

Task 7: Setting up SNMP agent

If SNMP is enabled, when an event occurs, the SNMP agent on the PTP 600 sends a trap to whatever SNMP trap receivers have been configured.

Depending upon which SNMP version is required, choose one of the following procedures:

- Configuring SNMPv3 agent on page 6-63
- Configuring SNMPv1/2c agent on page 6-72

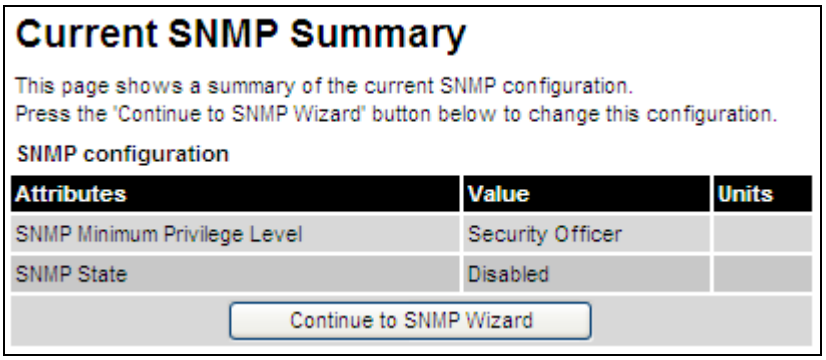
Configuring SNMPv3 agent

Perform this task to enable the PTP 600 to generate Simple Network Management Protocol version 3 (SNMPv3) traps.

Starting SNMP wizard

Select menu option **Management, SNMP**. The Current SNMP Summary page is displayed (Figure 131). Review the summary: if any updates are required, select **Continue to SNMP Wizard**.

Figure 131 Current SNMP Summary page (when SNMP is disabled)



Step 1: SNMP configuration (for SNMPv3)

When the Step 1: SNMP Configuration page is displayed, set SNMP State to 'Enabled' and set SNMP Version to 'v3'. The page is redisplayed with SNMPv3 attributes (Figure 132). Update the attributes (Table 113) and select **Next**.

Figure 132 Step 1: SNMP Configuration page (for SNMPv3)

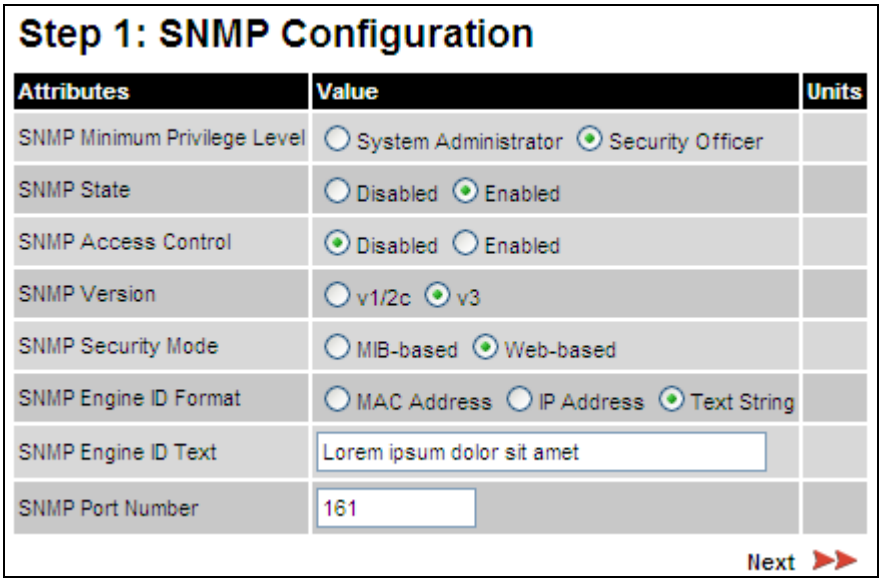


Table 113 Step 1: SNMP Configuration attributes (for SNMPv3)

Attribute	Meaning
SNMP Minimum Privilege Level	Minimum security level which is permitted to administer SNMP security settings.
SNMP State	Enables or disables SNMP.
SNMP Access Control	Enables or disables access control to SNMP management by IP address.
SNMP Access Control IP Address 1/2/3	A list of up to three IP addresses permitted to perform SNMP management. Only displayed when SNMP Access Control is 'Enabled'.
SNMP Version	SNMP protocol version: v1/2c or v3.
SNMP Security Mode	'MIB-based' means that SNMPv3 security parameters are managed via SNMP MIBs. 'Web-based' means that the SNMPv3 security parameters are not available over SNMP, but instead are configured using the SNMP Accounts page, as described in Step 3: SNMP user policy configuration (for SNMPv3) on page 6-66.

Attribute	Meaning
SNMP Engine ID Format	Specifies whether the Engine ID is generated from the MAC Address, IP Address or Text String.
SNMP Engine ID Text	Only enabled when SNMP Engine ID Format is set to 'Text String'. Text used to generate the SNMP Engine ID.
SNMP Port Number	Enter the port that the SNMP agent is listening to for commands from a management system.

Step 2: SNMP MIB-II System Objects (for SNMPv3)

The Step 2: SNMP MIB-II System Objects page is displayed (Figure 133). Update the attributes (Table 114) and select **Next**.

Figure 133 Step 2: SNMP MIB-II System Objects page (for SNMPv3)

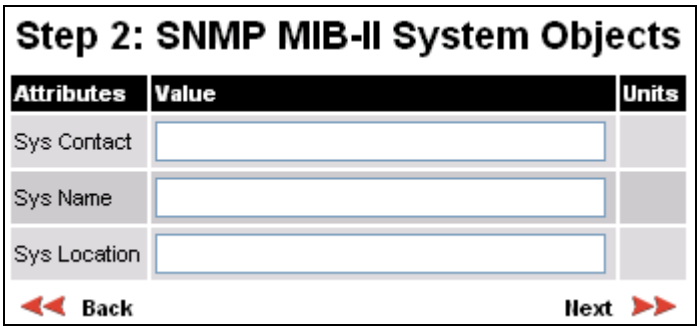


Table 114 Step 2: SNMP MIB-II System Objects attributes (for SNMPv3)

Attribute	Meaning
Sys Contact	The name of the contact person for this managed node, together with information on how to contact this person.
Sys Name	An administratively-assigned name for this managed node. By convention, this is the fully qualified domain name of the node.
Sys Location	The physical location of this node, for example 'Telephone closet, 3rd floor'.

The next step depends upon which SNMP Security Mode is selected in the Step 1: SNMP Configuration page:

- If it is 'Web-based', go to Step 3: SNMP user policy configuration (for SNMPv3) on page 6-66.
- If it is 'MIB-based', go to Confirming SNMP configuration (for SNMPv3) on page 6-70.

Step 3: SNMP user policy configuration (for SNMPv3)

The Step 3: SNMP User Policy Configuration page is displayed (Figure 134). If the chosen SNMP Security Mode is 'Web-based', then SNMP user accounts must be configured to access the unit. SNMP users may have one of two security profiles: 'System administrator' or 'Read only'.

Update the web-based security profile attributes (Table 115). These will determine which authentication and privacy protocols are required for SNMP users with roles 'System administrator' and 'Read only'. Select **Next**.

Figure 134 Step 3: SNMP User Policy Configuration page (for SNMPv3)

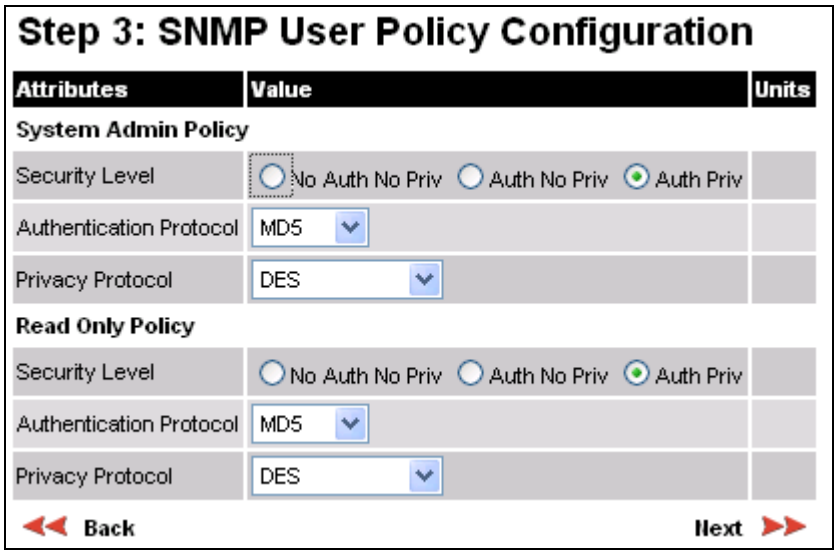


Table 115 Step 3: SNMP User Policy Configuration attributes (for SNMPv3)

Attribute	Meaning
Security Level	Defines the security level and associated protocols that are required to allow SNMP users to access the PTP 600. 'No Auth No Priv' means that users are not required to use authentication or privacy protocols. 'Auth No Priv' means that users are required to use only authentication protocols. 'Auth Priv' means that users are required to use both authentication and privacy protocols.
Authentication Protocol	The authentication protocol to be used to access the PTP 600 via SNMP. This is disabled when Security Level is set to 'No Auth No Priv'. 'MD5' means Message Digest Algorithm. 'SHA' means NIST FIPS 180-1, Secure Hash Algorithm SHA-1.
Privacy Protocol	The privacy protocol to be used to access the PTP 600 via SNMP. This is disabled when Security Level is set to 'No Auth No Priv' or 'Auth No Priv'. 'DES' means Data Encryption Standard (DES) symmetric encryption protocol. 'AES' means Advanced Encryption Standard (AES) cipher algorithm. **NOTE** A user configured to use AES privacy protocol will not be able to transmit and receive encrypted messages unless the license key enables the AES capability.

Step 4: SNMP user accounts configuration (for SNMPv3)

The Step 4: SNMP User Accounts Configuration page is displayed (Figure 135). If the chosen SNMP Security Mode is 'Web-based', then SNMP user accounts must be configured to access the unit. Update the individual user attributes (Table 116) for up to 10 SNMP users. Select **Next**.

Figure 135 Step 4: SNMP User Accounts Configuration page (for SNMPv3)

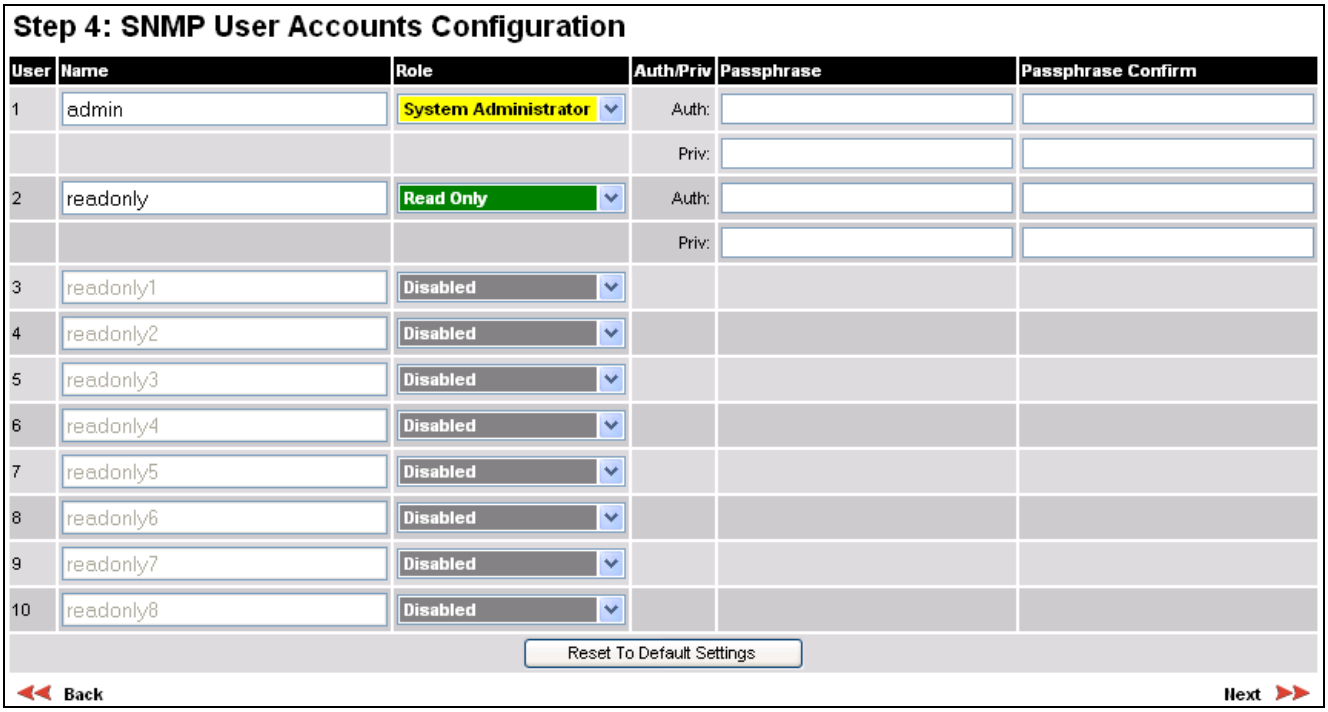


Table 116 Step 4: SNMP User Accounts Configuration attributes (for SNMPv3)

Attribute	Meaning
Name	Name to be used by the SNMP user to access the system.
Role	Selects which of the two web-based security profiles are applied to this user: 'System administrator' or 'Read only'. Select 'Disabled' to disable the SNMP account.
Auth/Priv	Indicates whether the Passphrase applies to authentication or privacy protocols.

Attribute	Meaning
Passphrase	The phrase to be entered by this SNMP user to access the system using an authentication or privacy protocol. Length must be between 8 and 32 characters. May contain spaces. The 'Auth:' Passphrase is hidden when Security Level for this user's Role is set to 'No Auth No Priv'. The 'Priv:' Passphrase is hidden when Security Level for this user's Role is set to 'No Auth No Priv' or 'Auth No Priv'.
Passphrase Confirm	Passphrase must be reentered to confirm it has not been mis-keyed.

Step 5: SNMP trap configuration (for SNMPv3)

The Step 5: SNMP Trap Configuration page is displayed (Figure 136). Update the attributes (Table 117) and select **Next**.

Figure 136 Step 5: SNMP Trap Configuration page (for SNMPv3)

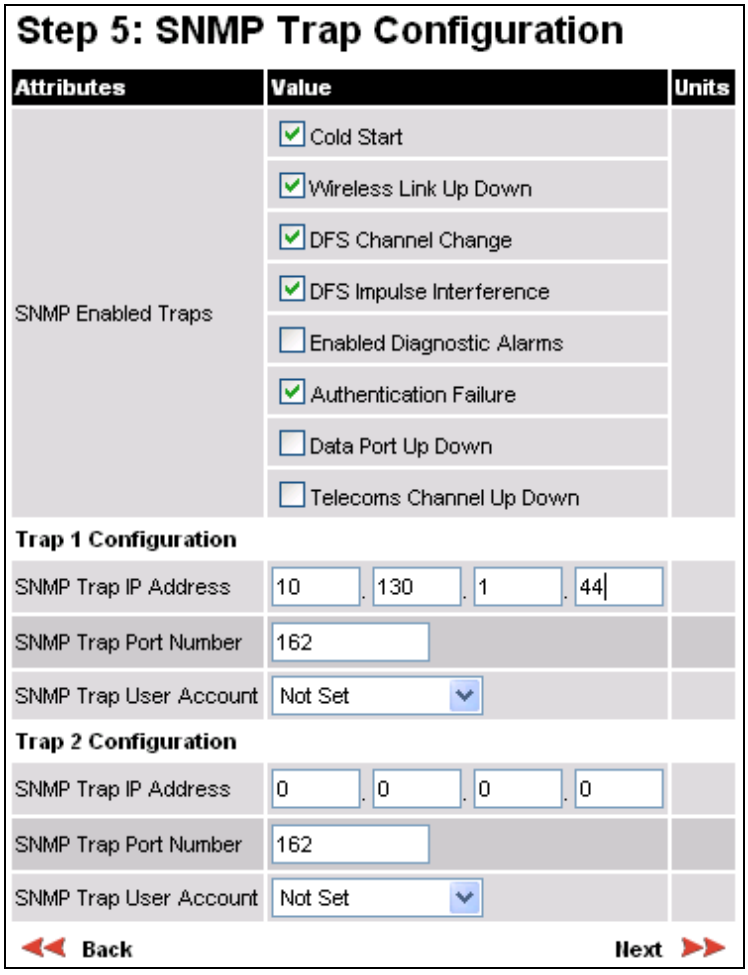


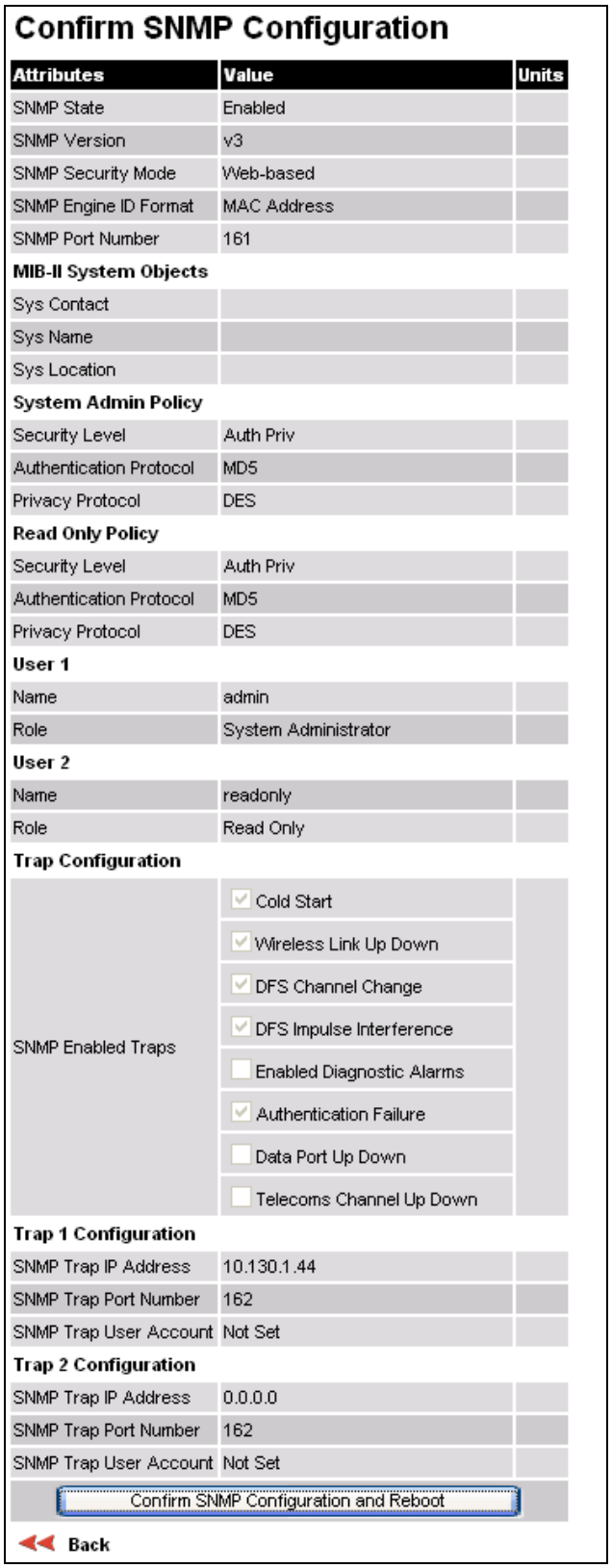
Table 117 Step 5: SNMP Trap Configuration attributes (for SNMPv3)

Attribute	Meaning
SNMP Enabled Traps	Select the events that will generate SNMP traps.
SNMP Trap IP Address 1	The IP address of the first SNMP server (trap receiver). This will normally be the network management system, but it may be a separate trap receiver. Enter zeros to disable logging on the first SNMP server.
SNMP Trap Port Number 1	The server 1 port at which SNMP traps are received.
SNMP Trap User Account 1	The user name (and associated protocols) to use when sending SNMP traps to server 1.
SNMP Trap IP Address 2	The IP address of the second SNMP server (trap receiver). This will normally be the network management system, but it may be a separate trap receiver. Enter zeros to disable logging on the second SNMP server.
SNMP Trap Port Number 2	The server 2 port at which SNMP traps are received.
SNMP Trap User Account 2	The user name (and associated protocols) to use when sending SNMP traps to server 2.

Confirming SNMP configuration (for SNMPv3)

When the Confirm SNMP Configuration page (Figure 137) is displayed, review the settings and select either **Back** or **Confirm SNMP Configuration and Reboot**. When the settings are confirmed, the unit reboots.

Figure 137 Confirm SNMP Configuration page (for SNMPv3)



Confirm SNMP Configuration

Attributes	Value	Units
SNMP State	Enabled	
SNMP Version	v3	
SNMP Security Mode	Web-based	
SNMP Engine ID Format	MAC Address	
SNMP Port Number	161	
MIB-II System Objects		
Sys Contact		
Sys Name		
Sys Location		
System Admin Policy		
Security Level	Auth Priv	
Authentication Protocol	MD5	
Privacy Protocol	DES	
Read Only Policy		
Security Level	Auth Priv	
Authentication Protocol	MD5	
Privacy Protocol	DES	
User 1		
Name	admin	
Role	System Administrator	
User 2		
Name	readonly	
Role	Read Only	
Trap Configuration		
SNMP Enabled Traps	☑ Cold Start ☑ Wireless Link Up Down ☑ DFS Channel Change ☑ DFS Impulse Interference ☐ Enabled Diagnostic Alarms ☑ Authentication Failure ☐ Data Port Up Down ☐ Telecoms Channel Up Down	
Trap 1 Configuration		
SNMP Trap IP Address	10.130.1.44	
SNMP Trap Port Number	162	
SNMP Trap User Account	Not Set	
Trap 2 Configuration		
SNMP Trap IP Address	0.0.0.0	
SNMP Trap Port Number	162	
SNMP Trap User Account	Not Set	

Confirm SNMP Configuration and Reboot

Back

Configuring SNMPv1/2c agent

Perform this task to enable the PTP 600 to generate Simple Network Management Protocol version 1 or 2c (SNMPv1 or SNMPv2c) traps.

Start SNMP wizard

To start the SNMP wizard, select menu option **Management, SNMP**. The Current SNMP Summary page is displayed (Figure 131). Review the summary. If any updates are required, select **Continue to SNMP Wizard**.

Step 1: SNMP Configuration (for SNMPv1/2c)

When the Step 1: SNMP Configuration page is displayed, set SNMP State to 'Enabled' and set SNMP Version to 'v1/2c'. The page is redisplayed with SNMPv1/2c attributes (Figure 138). Update the attributes (Table 118) and select **Next**.

Figure 138 Step 1: SNMP Configuration page (for SNMPv1/2c)

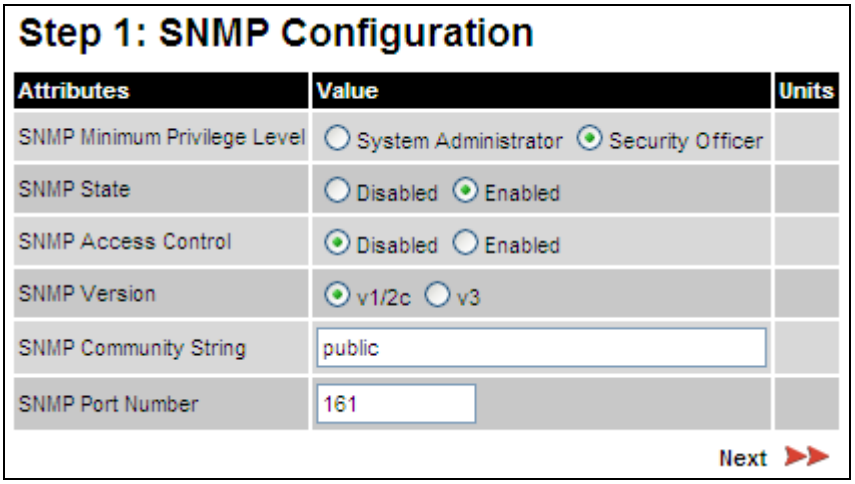


Table 118 Step 1: SNMP Configuration attributes (for SNMPv1/2c)

Attribute	Meaning
SNMP Minimum Privilege Level	Minimum security level which is permitted to administer SNMP security settings.
SNMP State	Enables or disables SNMP.
SNMP Access Control	Enables or disables access control to SNMP management by IP address.
SNMP Access Control IP Address 1/2/3	A list of up to three IP addresses permitted to perform SNMP management. Only displayed when SNMP Access Control is 'Enabled'.
SNMP Version	SNMP protocol version: v1/2c or v3.
SNMP Community String	The SNMP community string acts like a password between the network management system and the distributed SNMP clients (PTP 600 ODUs). Only if the community string is configured correctly on all SNMP entities can the flow of management information take place. By convention the default value is set to 'public'.
SNMP Port Number	Enter the port that the SNMP agent is listening to for commands from a management system.

Step 2: SNMP MIB-II System Objects (for SNMPv1/2c)

The Step 2: SNMP MIB-II System Objects page is displayed (Figure 139). Update the attributes (Table 119) and select **Next**.

Figure 139 Step 2: SNMP MIB-II System Objects page (for SNMPv1/2c)

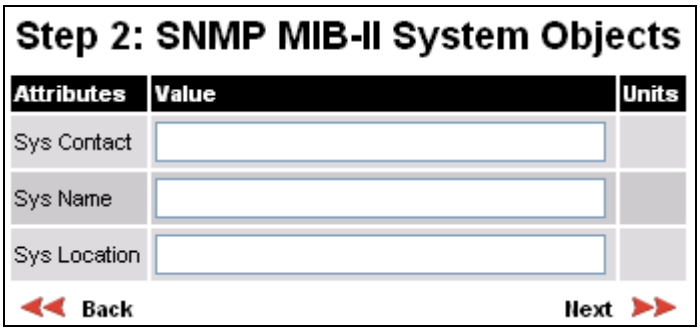


Table 119 Step 2: SNMP MIB-II System Objects attributes (for SNMPv1/2c)

Attribute	Meaning
Sys Contact	The name of the contact person for this managed node, together with information on how to contact this person.
Sys Name	An administratively-assigned name for this managed node. By convention, this is the fully qualified domain name of the node.
Sys Location	The physical location of this node, for example 'Telephone closet, 3rd floor'.

Step 3: SNMP Trap Configuration (for SNMPv1/2c)

The Step 3: SNMP Trap Configuration page is displayed (Figure 140). Update the attributes (Table 120) and select **Next**.

Figure 140 Step 3: SNMP Trap Configuration page (for SNMPv1/2c)

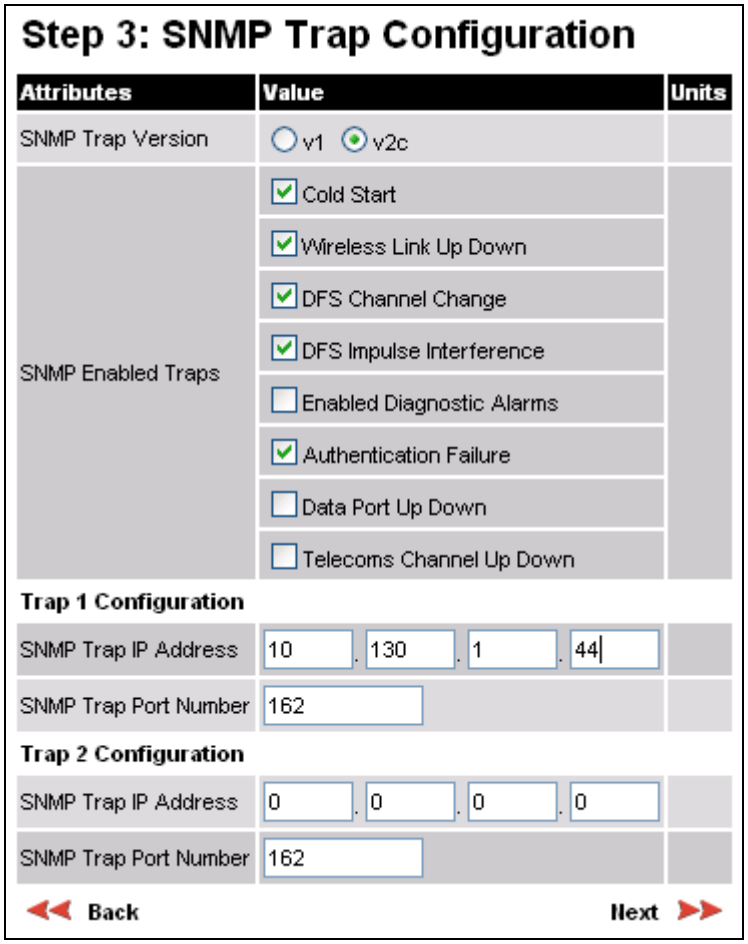


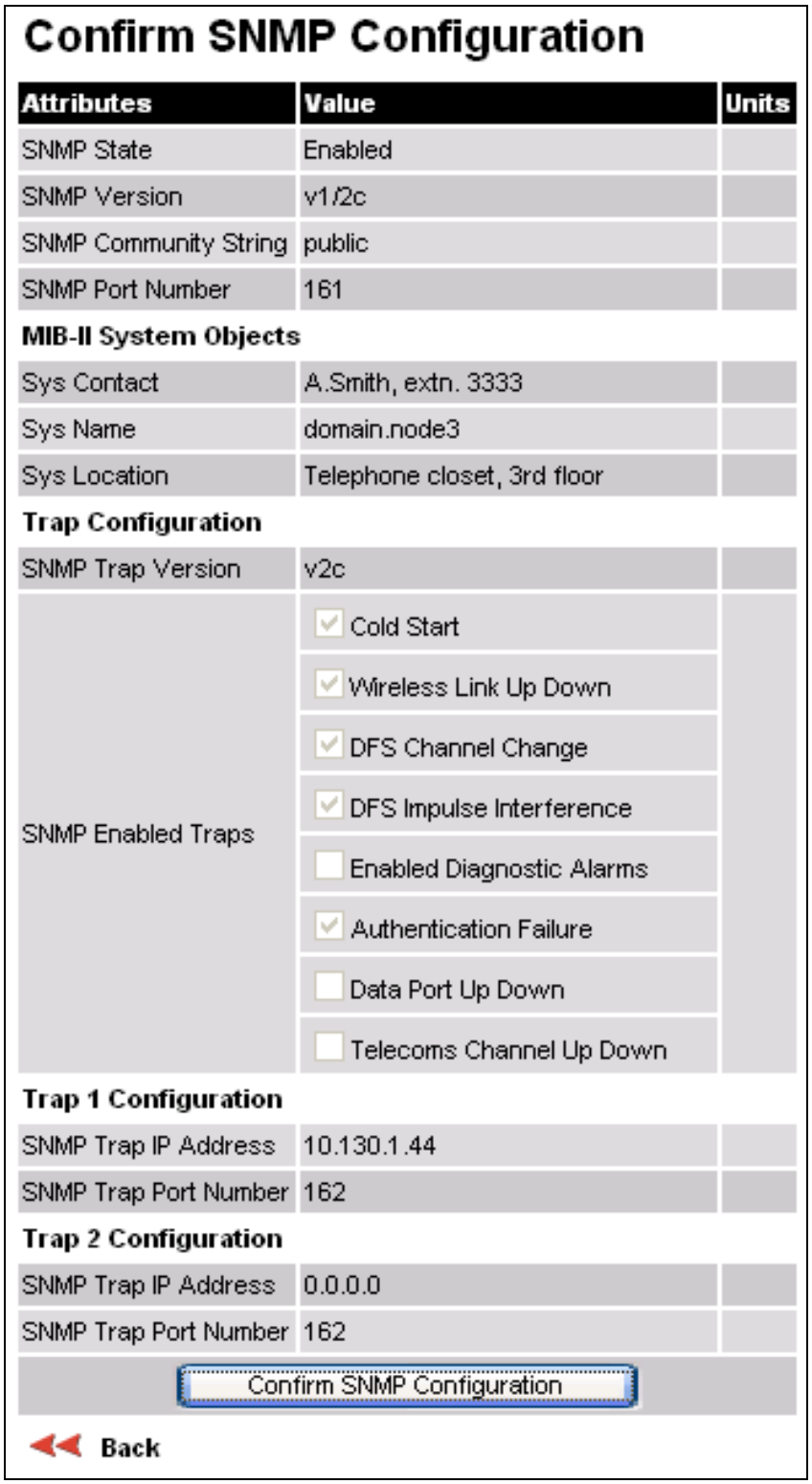
Table 120 Step 3: SNMP Trap Configuration attributes (for SNMPv1/2c)

Attribute	Meaning
SNMP Trap Version	Select the SNMP protocol version to use for SNMP traps: 'v1' or 'v2c'.
SNMP Enabled Traps	Select the events that will generate SNMP traps.
SNMP Trap IP Address 1	The IP address of the first SNMP server (trap receiver). This will normally be the network management system, but it may be a separate trap receiver. Enter zeros to disable logging on the first SNMP server.
SNMP Trap Port Number 1	The server 1 port at which SNMP traps are received.
SNMP Trap IP Address 2	The IP address of the second SNMP server (trap receiver). This will normally be the network management system, but it may be a separate trap receiver. Enter zeros to disable logging on the second SNMP server.
SNMP Trap Port Number 2	The server 2 port at which SNMP traps are received.

Confirm SNMP Configuration (for SNMPv1/2c)

When the Confirm SNMP Configuration page (Figure 141) is displayed, review the settings and select either **Back** or **Confirm SNMP Configuration and Reboot**. When the settings are confirmed, the unit reboots.

Figure 141 Confirm SNMP Configuration page (for SNMPv1/2c)



Confirm SNMP Configuration

Attributes	Value	Units
SNMP State	Enabled	
SNMP Version	v1/2c	
SNMP Community String	public	
SNMP Port Number	161	
MIB-II System Objects		
Sys Contact	A.Smith, extn. 3333	
Sys Name	domain.node3	
Sys Location	Telephone closet, 3rd floor	
Trap Configuration		
SNMP Trap Version	v2c	
SNMP Enabled Traps	☑ Cold Start	
	☑ Wireless Link Up Down	
	☑ DFS Channel Change	
	☑ DFS Impulse Interference	
	☐ Enabled Diagnostic Alarms	
	☑ Authentication Failure	
	☐ Data Port Up Down	
	☐ Telecoms Channel Up Down	
Trap 1 Configuration		
SNMP Trap IP Address	10.130.1.44	
SNMP Trap Port Number	162	
Trap 2 Configuration		
SNMP Trap IP Address	0.0.0.0	
SNMP Trap Port Number	162	

Confirm SNMP Configuration

Back

Task 8: Configuring alarms and messages

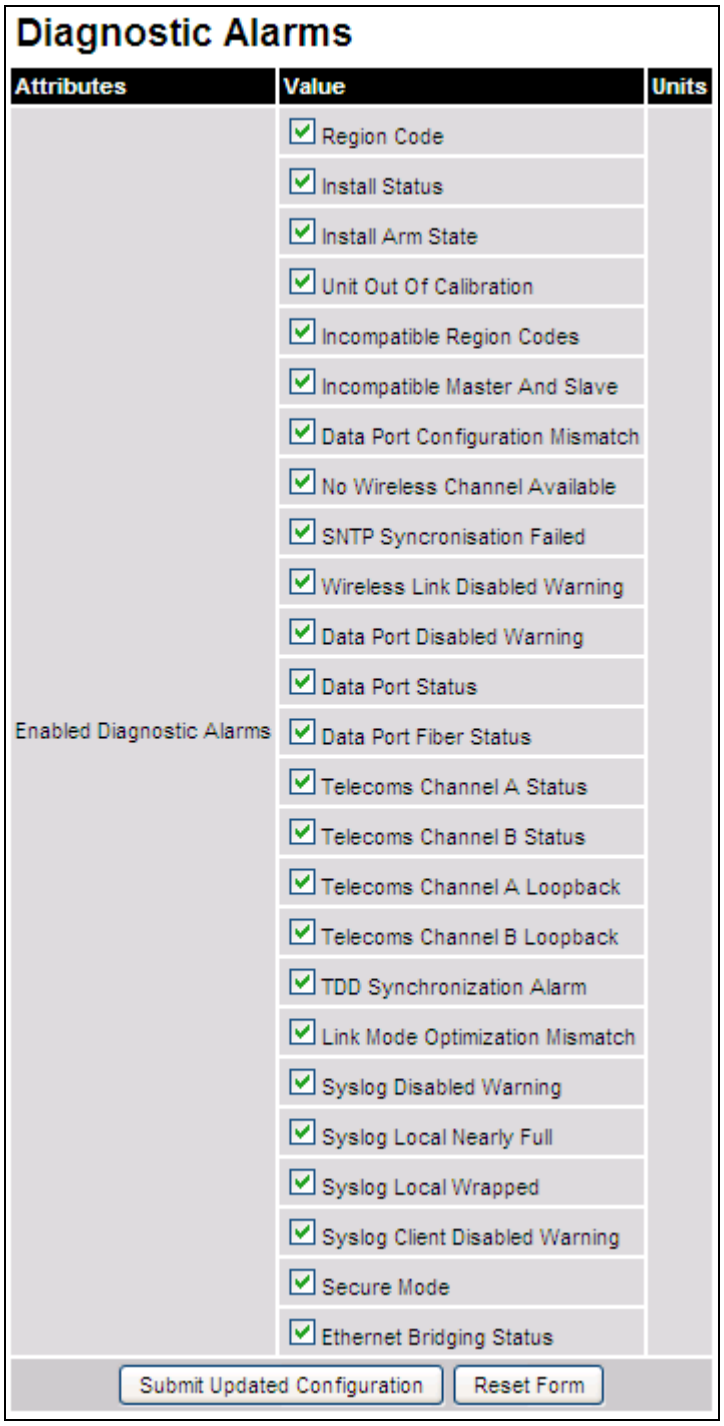
This task consists of the following procedures:

- Configuring generation of diagnostics alarms on page 6-77
- Configuring generation of email messages on page 6-79

Configuring generation of diagnostics alarms

Select menu option **Management, Diagnostic Alarms**. The Diagnostic Alarms page is displayed (Figure 142). To select which diagnostic alarms will be notified to the system administrator, tick the boxes against the required alarms. These alarms are described in Managing alarms on page 7-14. Select **Submit Updated Configuration**.

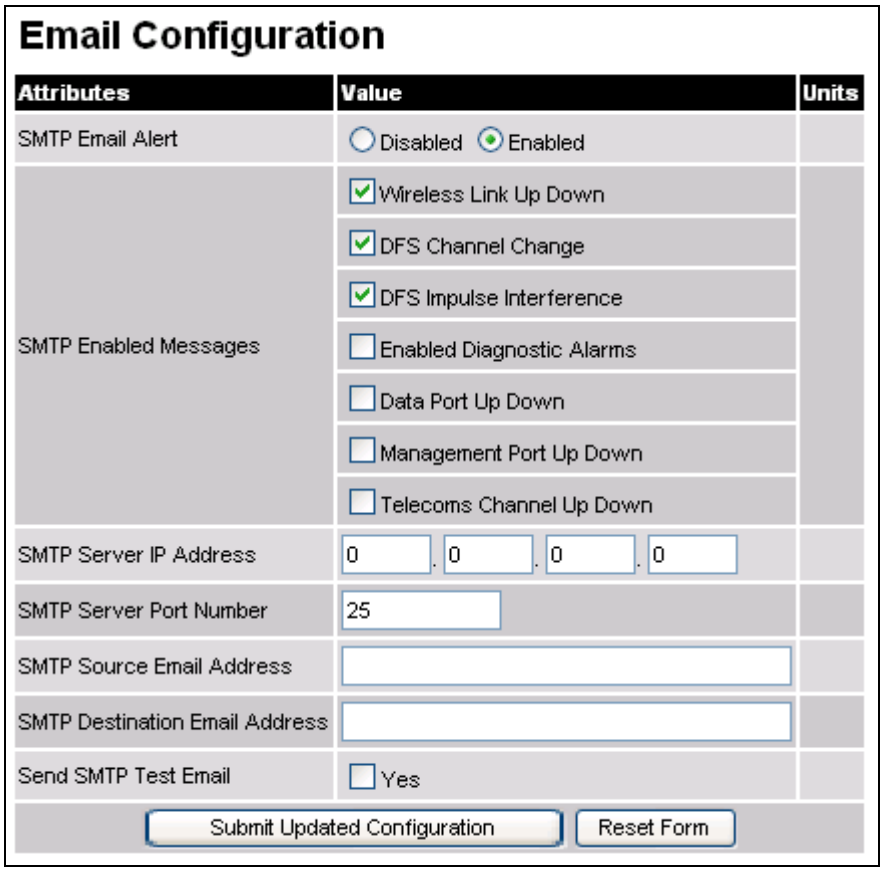
Figure 142 Diagnostic Alarms page



Configuring generation of email messages

To enable the PTP 600 to generate Simple Mail Transfer Protocol (SMTP) email messages to notify the system administrator when certain events occur, proceed as follows:

1 Select menu option **Management, Email**. The Email Configuration page is displayed:



2 Update the Email Configuration attributes (Table 121).

3 Select **Submit Updated Configuration**. The Configuration Change Reboot dialog is displayed.

4 Select **Reboot Wireless Unit**. The Reboot Confirmation dialog is displayed.

5 Select **OK**. The reboot progress message is displayed. On completion, the unit restarts.

Table 121 Email Configuration attributes

Attribute	Meaning
SMTP Email Alert	Controls the activation of the SMTP client.
SMTP Enabled Messages	The SMTP Enabled Messages attribute controls which email alerts the unit will send.
SMTP Server IP Address	The IP address of the networked SMTP server.
SMTP Server Port Number	The SMTP Port Number is the port number used by the networked SMTP server. By convention the default value for the port number is 25.
SMTP Source Email Address	The email address used by the PTP 600 Series to log into the SMTP server. This must be a valid email address that will be accepted by your SMTP Server.
SMTP Destination Email Address	The email address to which the PTP 600 Series will send the alert messages.
Send SMTP Test Email	Generate and send an email in order to test the SMTP settings. The tick box will self-clear when **Submit** is selected.

Task 9: Configuring syslog

This task is only performed when system logging is required.

For more information on syslog, refer to Managing event notification messages on page 7-19.

Configuring system logging (syslog)

Only users with 'Security Officer' role are permitted to configure the syslog client.

To configure system logging, select menu option **Management, Syslog, Syslog configuration**. The Syslog Configuration page is displayed (Figure 143). Update the attributes as required (Table 122) and select **Submit Updated Configuration**.

> **NOTE**
> To record Coordinated Universal Time (UTC time) in syslog messages, use the Time Configuration page to set Time Zone to 'GMT 00.00' and Daylight Saving to 'Disabled'. For more information, see Setting the real-time clock on page 6-100.

Figure 143 Syslog Configuration page

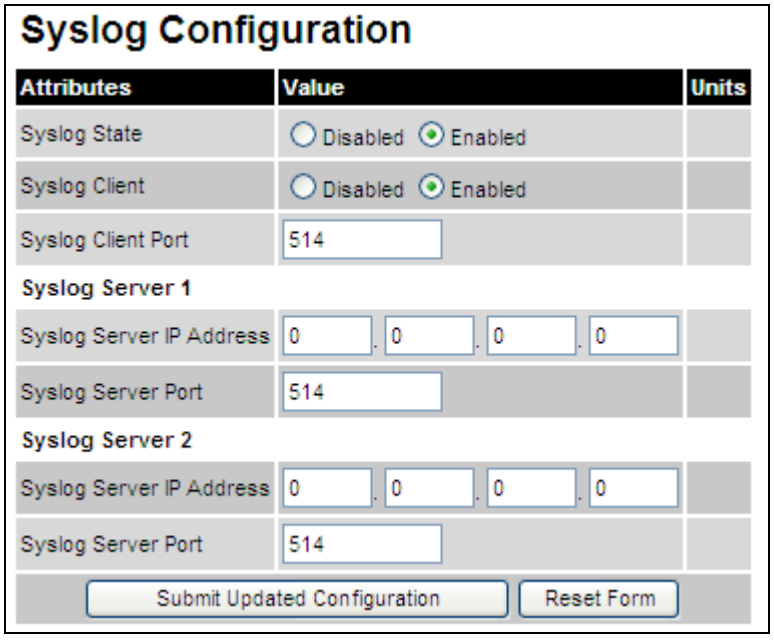


Table 122 Syslog Configuration attributes

Attribute	Meaning
Syslog Client	'Enabled' means that event messages are logged. 'Disabled' means that event messages are not logged.
Syslog Client Port	The client port from which syslog messages are sent.
Syslog Server 1 and 2:	
Syslog Server IP Address	The IP address of the syslog server. Enter zeros to disable logging on the syslog server.
Syslog Server Port	The server port at which syslog messages are received.

Task 10: Configuring remote access

Configuring web-based management attributes

The HTTP and Telnet interfaces should be disabled if the HTTPS interface is configured. See Configuring HTTPS/TLS page 6-23.

⚠ CAUTION

If the HTTP, HTTPS, Telnet and SNMP interfaces are all disabled, then it will be necessary to use the Recovery image to reset IP & Ethernet Configuration back to factory defaults to re-enable the interfaces.

Select menu option **Management, Web**. The Web-Based Management page is displayed (Figure 144). Update the attributes as required (Table 123) and select **Submit Updated Configuration**.

Figure 144 Web-Based Management page

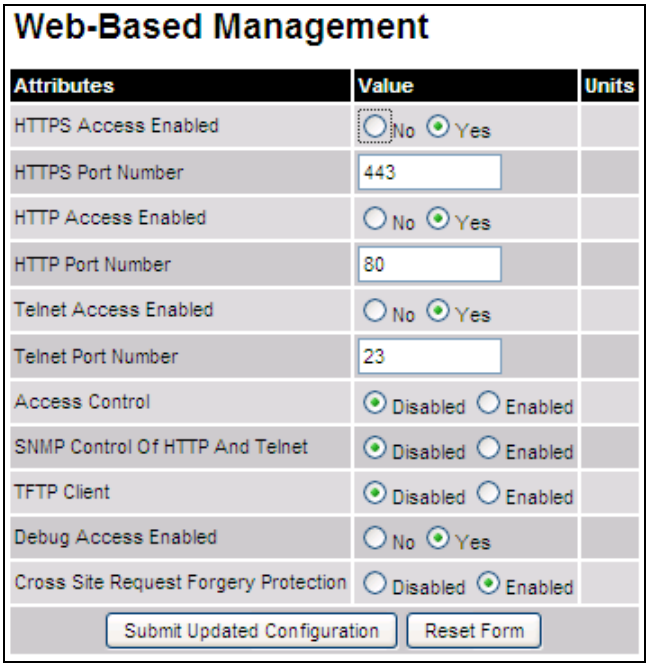


Table 123 Web-Based Management attributes

Attribute	Meaning
HTTPS Access Enabled	Only displayed when HTTPS is configured. Shows the current status of HTTPS access (enabled or not).

Attribute	Meaning
HTTPS Port Number	Only displayed when HTTPS is configured. The port number for HTTPS access. A value of zero means the wireless unit uses the default port.
HTTP Access Enabled	'No' means that the unit will not respond to any requests on the HTTP port. 'Yes' means that the unit will respond to requests on the HTTP port. Remote management via HTTPS is not affected by this setting.
HTTP Port Number	The port number for HTTP access. A value of zero means the wireless unit uses the default port.
Telnet Access Enabled	'No' means that the unit will not respond to any requests on the Telnet port. 'Yes' means that the unit will respond to requests on the Telnet port.
Telnet Port Number	The port number for Telnet access. A value of zero means the wireless unit uses the default port.
Access Control	Enables or disables access control to web-based management by IP address.
Access Control IP Address 1/2/3	A list of up to three IP addresses permitted to perform web-based management. Only displayed when Access Control is 'Enabled'.
SNMP Control of HTTP And Telnet	'Disabled' means that neither HTTP nor Telnet can be controlled remotely via SNMP. 'Enabled' means that both HTTP and Telnet can be controlled remotely via SNMP.
TFTP Client	'Disabled' means that the unit will not respond to any TFTP software download requests. 'Enabled' means that software can be downloaded via TFTP, as described in Upgrading software on page 7-49.
Debug Access Enabled	'Yes' means that Cambium Technical Support is allowed to access the system to investigate faults.
Cross Site Request Forgery Protection	'Enabled' means that the system is protected against cross-site request forgery attacks at the web-based interface.

Task 11: Aligning antennas

Before performing this task, check that hardware installation is complete (apart from the network connections) at both the Master and Slave sites.

This task consists of the following procedures:

- Starting up the units on page 6-85
- Checking that the units are armed on page 6-85
- Aligning antennas on page 6-86
- Aligning separate antennas for spatial diversity on page 6-87
- Monitoring received signal level on page 6-88.
- Disarming the units on page 6-91

Starting up the units

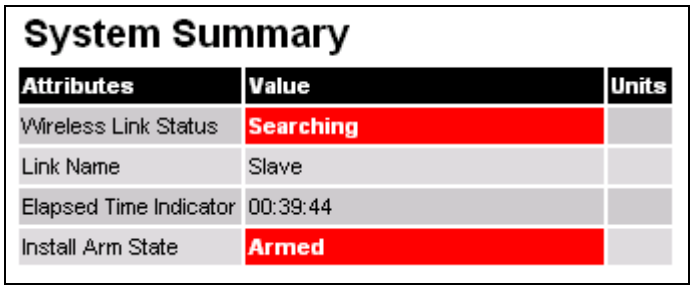
To connect one of the units to a management PC and start up both units, proceed as follows:

1. Select the unit from which this process is to be controlled; either Master or Slave. This is the ‘local’ unit.
2. Check that the management PC is connected to the local unit, powered up and logged on.
3. Start the local unit.
4. Start the remote unit.
5. Log into the local unit as described in Logging into the web interface on page 6-5.

Checking that the units are armed

Select menu option **Home**. The System Summary page is displayed. Check that the Install Arm State is set to ‘Armed’ (Figure 145); this confirms that the units are ready for alignment.

Figure 145 System Summary page (when unit is armed)



If the units are not armed, execute the installation wizard as described in Task 6: Configuring wireless and telecoms interfaces on page 6-45.

Aligning antennas

Use this procedure to align linked antennas (master and slave), whether integrated or connectorized.

Prior to alignment, ensure that the following parameters are available:

- Location of both sites (latitude and longitude).
- Bearing to the other end of the link for both sites.
- Prediction of receive signal level for both ends of the link.
- Prediction of link loss.

PTP LINKPlanner provides all of these parameters in the form of an installation report.

If a connectorized ODU is installed at either site with two separate antennas for spatial diversity, refer to Aligning separate antennas for spatial diversity on page 6-87 before starting alignment.

NOTE

To achieve best results, make small incremental changes to elevation and azimuth.

CAUTION

The action of tightening the mounting bolts can alter antenna alignment. This can be helpful when fine-tuning alignment, but it can also lead to misalignment. To prevent misalignment, continue to monitor receive signal level during final tightening of the bolts.

To align the antennas, proceed as follows:

1. At each end of the link, adjust the antenna to point at the other end of the link. This should be done with the aid of a compass.
2. Without moving the master antenna, adjust the elevation and azimuth of the slave antenna to achieve the highest receive signal level (using one of the recommended methods in Monitoring received signal level on page 6-88).
3. Without moving the Slave antenna, adjust the elevation and azimuth of the Master antenna to achieve the highest receive signal level (using one of the three recommended methods).
4. Repeat steps 2 and 3 as necessary to fine-tune the alignment to find the center of the beam.
5. When the antennas have been aligned on the center of the beam, verify that the receive level is within the predicted range (from the installation report). If this is not the case, go back to step 2.

   The current value of receive level can be verified by using the graphical installation method (see Method #2: graphical install on page 6-90) or by selecting menu option **Status** and monitoring the Receive Power attribute on the System Status page.
6. If after repeated attempts to align, the receive level still does not lie within the predicted range, this may be because the data provided to the prediction tool (such as PTP LINKPlanner) is inaccurate. For example estimates of path obstructions, antenna heights or site locations may be inaccurate. Check this data and update the prediction as necessary.
7. Once the antennas have been aligned correctly, tighten the integrated ODU (or connectorized antenna) mountings. To ensure that the action of tightening does not alter antenna alignment, continue to monitor received signal level.

Aligning separate antennas for spatial diversity

If a connectorized ODU is installed at either site with two separate antennas for spatial diversity, proceed as follows:

1. Connect the horizontal polarization antenna to the ODU, disconnect the vertical polarization antenna, then perform Aligning antennas on page 6-86.
2. Connect the vertical polarization antenna to the ODU, disconnect the horizontal polarization antenna, then perform Aligning antennas on page 6-86.
3. Re-connect the horizontal polarization antennas. The received signal level should increase.
4. Weatherproof the antenna connections at the ‘H’ and ‘V’ interfaces of the ODUs, as described in Mounting and connecting antenna on page 5-10.

Monitoring received signal level

The goal of antenna alignment is to find the center of the main beam. This is done by adjusting the antennas while monitoring the receive signal level. Choose one of two methods for monitoring receive signal level:

- Method #1: ODU installation tones on page 6-88
- Method #2: graphical install on page 6-90

Method #1: ODU installation tones

This is the first of two methods that may be used to monitor receive signal level during antenna alignment.

The ODU emits audible tones during installation to assist with alignment. The pitch of the alignment tone is proportional to the received power of the wireless signals. Adjust the alignment of the unit in both azimuth and elevation until the highest pitch tone is achieved.

> **NOTE**
> When using ODU installation tones to align connectorized antennas, it may not be possible to hear the tones. To overcome this problem, either use an assistant, or use a stethoscope to give a longer reach.

The tones and their meanings are described in Table 124. In each of the states detailed in the table, align the unit to give the highest pitch tone.

Table 124 ODU installation tones

State Name	Tone Description	State Description	Pitch Indication
Free Channel Search	Regular beep	Executing band scan	N/A
Scanning	Slow broken tone	Not demodulating the wanted signal	Rx Power
Synchronized	Fast broken tone	Demodulating the wanted signal	Rx Power
Registered	Solid tone	Both Master and Slave units exchanging Radio layer MAC management messages	Rx Power
Alarm	Fast broken dual tone	A fatal error has occurred.	

The term ‘wanted signal’ refers to that of the peer unit being installed.

⚠ CAUTION

If, when in the Synchronized or Registered state, the tone varies wildly, there may be interference or a fast fading link. Installing in this situation may not give a reliable link. Investigate the cause of the problem.

During alignment, the installation tones should exhibit the following behavior:

- **Band scan:** When first started up and from time to time, the Master unit will carry out a band scan to determine which channels are not in use. During this time, between 10 and 15 seconds, the Master unit will not transmit and as a consequence of this neither will the Slave unit. During this time the installation tone on the master unit will drop back to the band scan state, and the Slave unit will drop back to the Scanning state with the pitch of the tone set to the background noise level. Alignment of the unit should cease during this time.
- **Radar detection:** If the unit is operating where mandatory radar avoidance algorithms are implemented, the ranging behavior may be affected. The Master has to monitor the initially chosen channel for 60 seconds to make sure it is clear of radar signals before transmitting. If a radar is detected during any of the installation phases, a further compulsory 60 seconds channel scan will take place as the master unit attempts to locate a new channel that is free of radar interference.
- **Ranging:** The PTP 600 Series does not require the user to enter the link range. The Master unit typically takes less than 60 seconds to determine the length of the link being installed. The Master unit will remain in the Scanning state until the range of the link has been established. The Master unit will only move to the Synchronized state when the range of the link has been established.

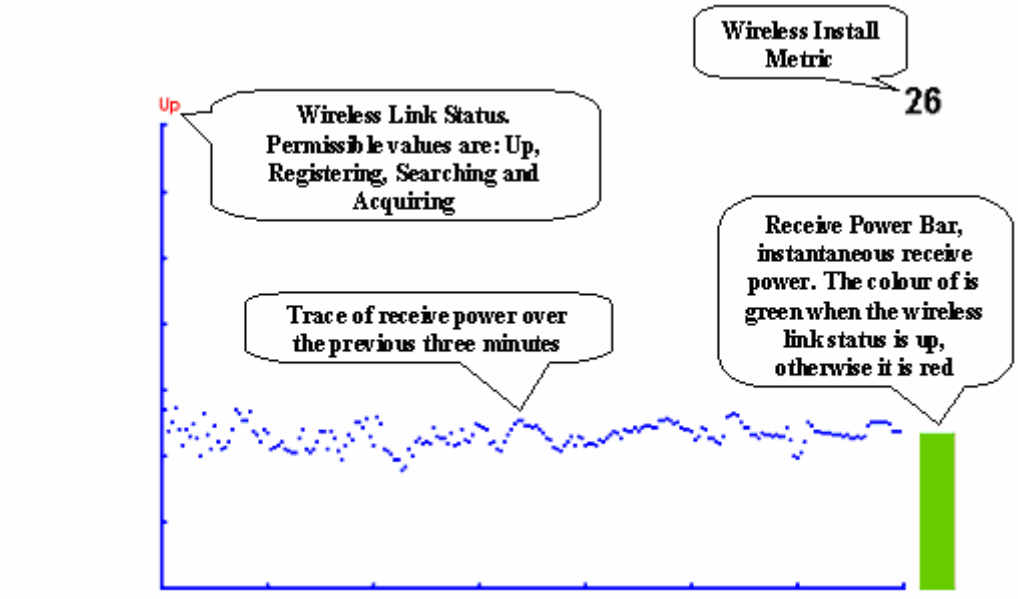
  The Slave unit does not have a ranging process. The slave unit will change to the Synchronized state as soon as the wanted signal is demodulated.
- **Retrying same channel:** If, at the end of the ranging period, the Registered state is not achieved due to interference or other reasons, the Master unit will retry twice more on the same channel before moving to another available channel. Should this occur it might take a number of minutes to establish a link in the Registered state.

Method #2: graphical install

This is the second of two methods that may be used to monitor receive signal level during antenna alignment.

Select menu option **Installation, Graphical Install**. The Graphical Install page is displayed (Figure 146).

Figure 146 Graphical installation page


Wireless Install Metric
26
Up
Wireless Link Status. Permissible values are: Up, Registering, Searching and Acquiring
Receive Power Bar, instantaneous receive power. The colour of is green when the wireless link status is up, otherwise it is red
Trace of receive power over the previous three minutes

The screen displays the receive power over the last three minutes. This will allow the installer to slowly sweep the antenna during installation and monitor the variation in signal strength with angular position. The screen automatically refreshes every three seconds.

The screen also displays the current state of the wireless link in two ways. First, the actual state of the wireless link is written in the top left corner of the screen. The instantaneous receive power bar also encodes the state of the wireless link using green to signify that the wireless link is up and red for all other states.

The installation metric is simply the instantaneous receive power in dBm + 110.

PDA version: To access the PDA version of the graphical installation tool, use a hidden URL -
http://<ip-address>/pda.cgi. This link is only available to system administrators.

Disarming the units

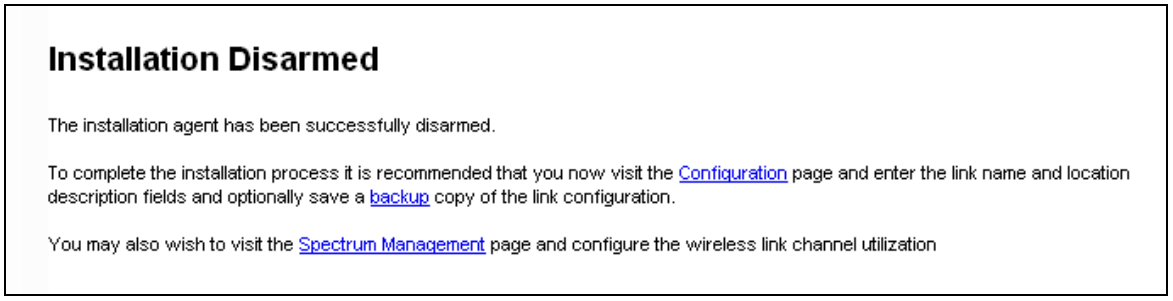
When antenna alignment is complete, both units in the link must be disarmed in order to:

- Turn off the audible alignment aid.
- Enable adaptive modulation.
- Fully enable spectrum management features (such as i-DFS, if configured).
- Clear unwanted installation information from the various systems statistics.
- Store the link range for fast link acquisition on link drop.
- Enable higher data rates.

> **NOTE**
> After 24 hours, the units will be disarmed automatically, provided that they are armed and that the link is up.

To disarm the units, select menu option **Installation**. The Disarm Installation page is displayed (Figure 122). Select **Disarm Installation Agent**. The confirmation pages is displayed (Figure 147).

Figure 147 Optional post-disarm configuration


Installation Disarmed
The installation agent has been successfully disarmed.
To complete the installation process it is recommended that you now visit the Configuration page and enter the link name and location description fields and optionally save a backup copy of the link configuration.
You may also wish to visit the Spectrum Management page and configure the wireless link channel utilization

To proceed directly to Task 12: Updating system configuration on page 6-92, click the Configuration link on the above page.

Task 12: Updating system configuration

Reviewing system configuration attributes

When antenna alignment is complete and the units have been disarmed, the system configuration should be reviewed and updated as necessary.

NOTE

At this stage, Max Transmit Power must be set to the maximum value (dBm) for normal operation, as recommended in the installation report.

WARNING

When installing or operating the PTP 54600 and PTP 58600 ATEX/Hazloc product variants in hazardous locations, ensure that the EIRP and Max Transmit Power do not exceed ATEX or Hazloc limits, as specified in the *PTP 600 Series Hazardous Location Guide* (supplied in box with the products).

To update the system configuration, select menu option **System, Configuration**. The System Configuration page is displayed (Figure 148). Update the attributes as required (Table 125), then select **Submit Updated System Configuration**.

Figure 148 System Configuration page

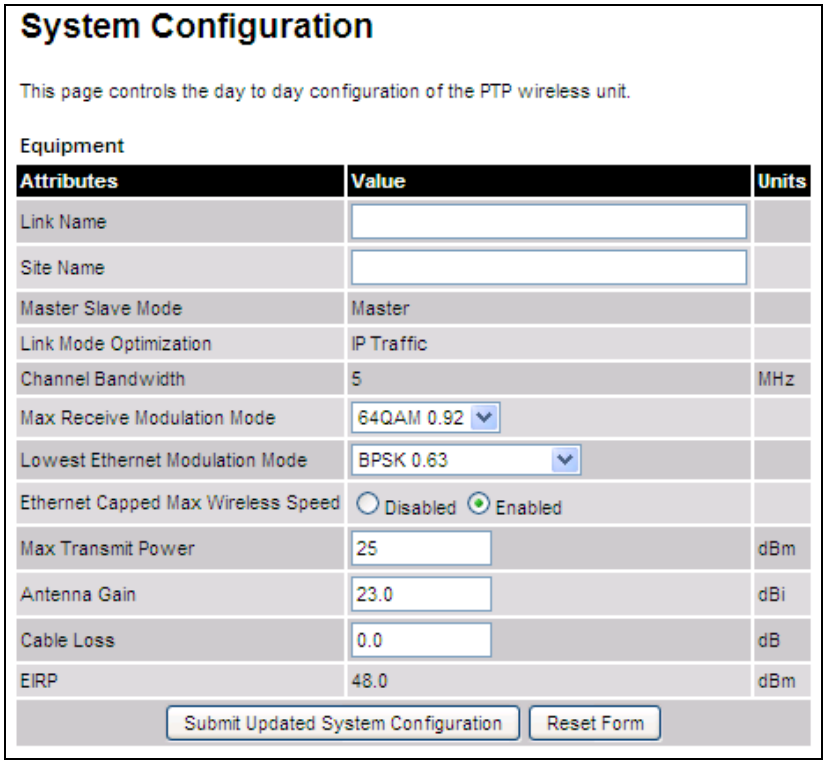


Table 125 System Configuration attributes

Attribute	Meaning
Link Name	User defined identity for the unit. If Link Name Access is enabled, this is updated in Step 2: Wireless configuration on page 6-51.
Site Name	User defined name for the site, with additional notes (if required).
Master Slave Mode	Read only. Updated in Step 2: Wireless configuration on page 6-51.
Link Mode Optimization	Read only. Updated in Step 2: Wireless configuration on page 6-51.
Channel Bandwidth	Read only. Updated in Step 2: Wireless configuration on page 6-51.
Max Receive Modulation Mode	The maximum mode the unit will use as its adaptive modulation. By default the Max Receive Modulation Mode is the highest mode available. For minimum error rates, set the maximum modulation mode to the minimum necessary to carry the required traffic.
Lowest Ethernet Modulation Mode	The lowest modulation mode that must be achieved before the link is allowed to bridge Ethernet frames.
Ethernet Capped Max Wireless Speed	When enabled, this option will cap the wireless speed to a mode that the connected Ethernet connection can sustain.
Max Transmit Power	This is the maximum transmit power at which the unit will operate, configurable in steps of 1 dB. Its maximum setting is dependent on the region of operation and this is controlled by the license key. Set this to the maximum value (dBm) for normal operation as recommended by PTP LINKPlanner. This may be a higher value than that used for alignment.
Antenna Gain	This is only displayed when Platform Variant is set to 'Connectorized' in Step 2 of the Installation wizard. Updated in Step 2: Wireless configuration on page 6-51.
Cable Loss	This is only displayed when Platform Variant is set to 'Connectorized' in Step 2 of the Installation wizard. Updated in Step 2: Wireless configuration on page 6-51.

Attribute	Meaning
EIRP	This is only displayed when Platform Variant is set to 'Connectorized' in Step 2 of the Installation wizard. Effective Isotropic Radiated Power (EIRP) describes the strength of the radio signal leaving the wireless unit. Use it to verify that the link configuration (Max Transmit Power, Antenna Gain and Cable Loss) does not exceed any applicable regulatory limit.
Encryption Algorithm	This is only displayed when AES encryption is enabled by licensed key. Updated in Task 5: Configuring security on page 6-21.
Encryption Key	This is only displayed when AES encryption is enabled by licensed key. Updated in Task 5: Configuring security on page 6-21.
Confirm Encryption Key	This is only displayed when AES encryption is enabled by licensed key. Updated in Task 5: Configuring security on page 6-21.

Task 13: Checking wireless performance

Comparing actual to predicted performance

For at least one hour of operation after disarming, the link should be monitored to check that it is achieving predicted levels of performance.

To check performance, select menu option **System, Statistics**. The System Statistic page is displayed (Figure 176). Monitor the following attributes:

- Link Loss
- Transmit Data Rate
- Receive Data Rate

PTP LINKPlanner provides the prediction in the form of an installation report.

For more information, refer to Managing spectrum on page 7-20.

Task 14: Configuring quality of service

Configuring quality of service

To configure the classification of priority encoded Ethernet frames into up to eight traffic classes, select menu option **System, Configuration, QoS Configuration**. The QoS Configuration page is displayed (Figure 149 or Figure 150).

Update the Layer 2 Control Protocols (Table 126) and Ethernet Priority Que mapping (Table 127) as required.

To use IEEE 802.1Q classification rules, select **Reset Default Priority Mappings**. The 802.1Q rules are shown in Table 127.

Select Submit **Updated Configuration**.

Figure 149 QoS Configuration page (Ethernet)

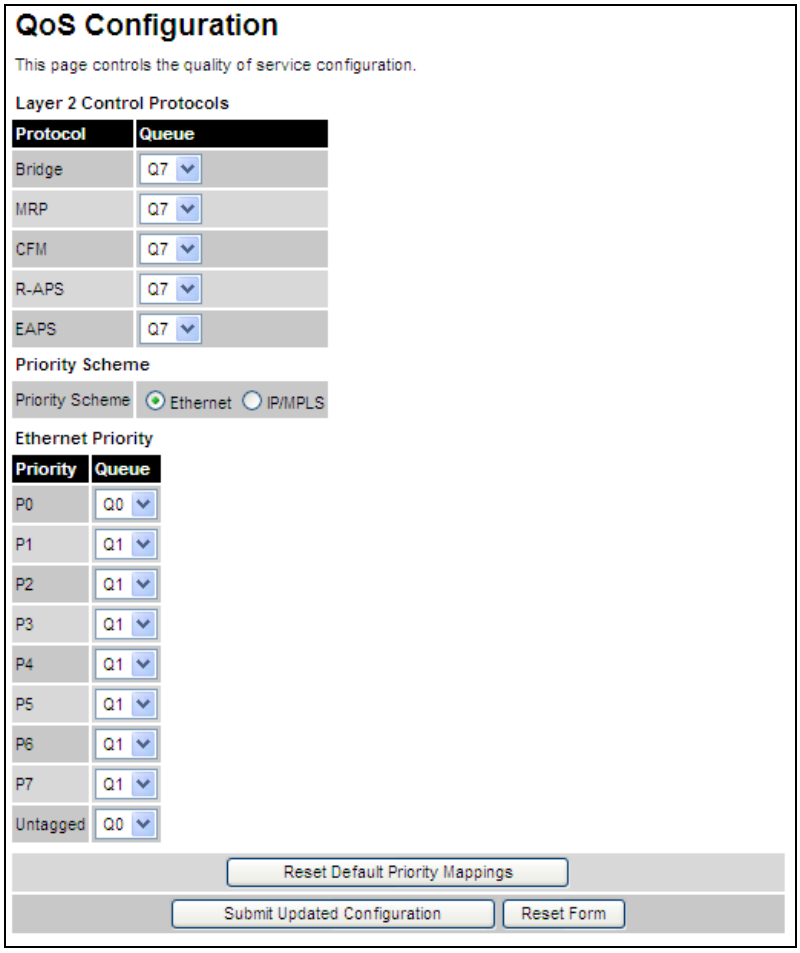


Figure 150 QoS Configuration page (IP/MPLS)

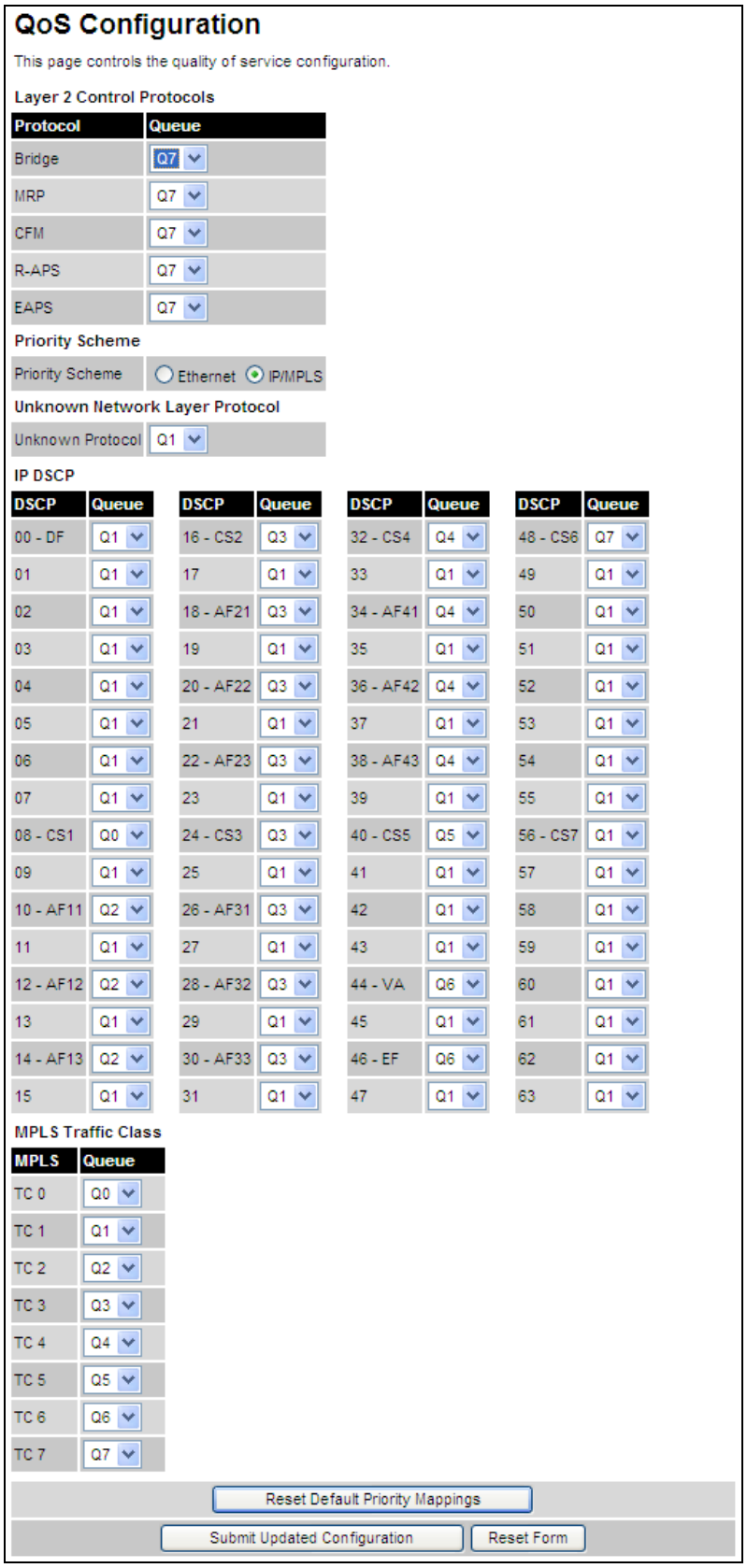


Table 126 Layer 2 Control Protocols

Attribute	Meaning
Bridge	The classification of each layer 2 control protocol (L2CP) to an egress queue at the wireless port.
MRP	
CFM	
R-APS	
EAPS	
Priority Scheme	Classification is based on fields in the Ethernet header (Layer 2) or in the Network header (Layer 3). The unit recognizes two network layer protocols: IP and MPLS.
Unknown Protocol	The classification of unknown network protocols (not IP or MPLS) to an egress queue at the wireless port. Only displayed when Priority Scheme is IP/MPLS.

Table 127 Ethernet Priority Queue settings

VLAN Priority	QoS default traffic class	IEEE802.1Q traffic class
P0	Q0	Q1
P1	Q1	Q0
P2	Q1	Q2
P3	Q1	Q3
P4	Q1	Q4
P5	Q1	Q5
P6	Q1	Q6
P7	Q1	Q7
Untagged	Q0	Q1

Task 15: Connecting link to the network

Perform this task to connect to the network and set the system clock.

Depending upon the chosen management mode, perform one of the following procedures:

- Connecting to the network with in-band management on page 6-99
- Connecting to the network with out-of-band management on page 6-100

When network connection is successful, perform this procedure:

- Setting the real-time clock on page 6-100

Connecting to the network with in-band management

To connect to the network when in-band management has been configured, proceed as follows:

1. Disconnect the local PC from the PIDU at the Master and Slave sites.
2. At each site, connect the PIDU LAN ports to a router port, switch port or other network equipment in the data network using the Cat5e cable that was prepared for this purpose in Preparing the PIDU to LAN cable on page 5-31.
3. Check that the Master and Slave units are reachable from the network management system by opening the web interface to the management agents, or by requesting ICMP echo response packets using the Ping application. The network management system will normally be geographically remote from the sites, so it may be necessary to request that this action is completed by co-workers at the management center. Alternatively, it may be possible to use remote login to the management system.
4. Check the data network for correct operation across the wireless link. This may be by requesting ICMP echo response packets between hosts in the connected network segments, or by some more structured use of network testing tools.
5. Select menu option **Home** or **Status** and check that the Wireless Link Status is ‘Up’ on both units. If it is not ‘Up’, refer to Managing alarms and events on page 7-14.

Connecting to the network with out-of-band management

To connect to the network with out-of-band management, proceed as follows:

1. Disconnect the local PC from the PIDU at the Master and Slave sites.
2. At each site, connect the OOBM drop cable to a router port, switch port or other network equipment in the management network. The OOBM drop cable was prepared for this purpose in Installing OOBM on page 5-55.
3. Check that the Master and Slave units are reachable from the network management system by opening the web interface to the management agents, or by requesting ICMP echo response packets using the Ping application. The network management system will normally be geographically remote from the sites, so it may be necessary to request that this action is completed by co-workers at the management center. Alternatively, it may be possible to use remote login to the management system.
4. At each site, connect the PIDU LAN ports to a router port, switch port or other network equipment in the customer data network using the Cat5e cable that was prepared for this purpose in Preparing the PIDU to LAN cable on page 5-31.
5. Check the data network for correct operation across the wireless link. This may be by requesting ICMP echo response packets between hosts in the connected network segments, or by some more structured use of network testing tools.
6. Select menu option **Home** or **Status** and check that the Wireless Link Status is ‘Up’ on both units. If it is not ‘Up’, refer to Managing alarms and events on page 7-14.

Setting the real-time clock

Perform this task to set the real-time clock of the PTP 600.

Setting the real-time clock manually

To keep time without connecting to a networked time server, select menu option **Management, Time.** The Time Configuration page is displayed (Figure 151). Set SNTP State to ‘Disabled’. Review and update the manual clock attributes (Table 128) and select **Submit Updated Configuration**.

Figure 151 Time Configuration page (SNTP disabled)

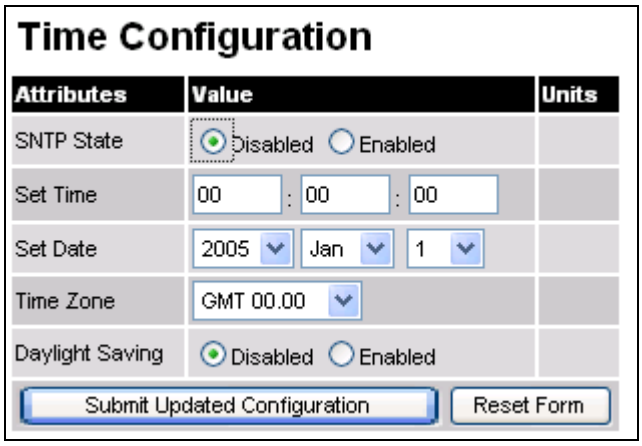


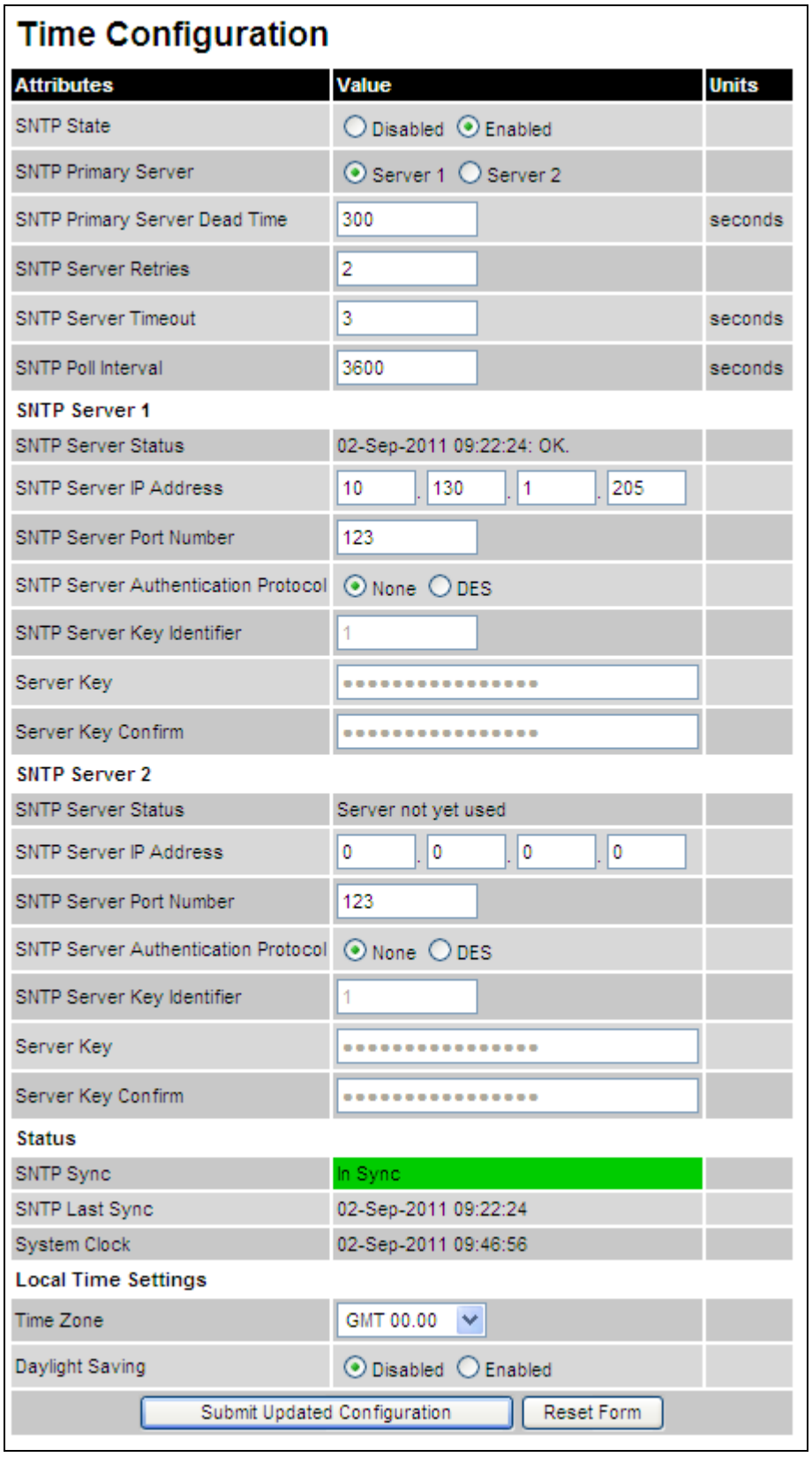
Table 128 Manual clock attributes

Attribute	Meaning
SNTP State	'Disabled' means that the PTP 600 will keep time without connecting to a networked time server.
Set Time	Set hours, minutes and seconds.
Set Date	Set year, month and day.
Time Zone	Set the time zone offset from Greenwich Mean Time (GMT). To set the clock to UTC time, set Time Zone to 'GMT 00.00'.
Daylight Saving	'Disabled' means that daylight saving adjustments will not be applied to the time. 'Enabled' means that daylight saving adjustments will be applied, according to local rules. To set the clock to UTC time, set Daylight Saving to 'Disabled'.

Setting the real-time clock to synchronize using SNTP

To synchronize with a networked time server, select menu option **Management, Time.** The Time Configuration page is displayed (Figure 152). Set the SNTP State attribute to 'Enabled'. Review and update the SNTP clock attributes (Table 129) and select **Submit Updated Configuration**.

Figure 152 Time Configuration page (SNTP enabled)



Time Configuration

Attributes	Value	Units
SNTP State	○ Disabled ◉ Enabled	
SNTP Primary Server	◉ Server 1 ○ Server 2	
SNTP Primary Server Dead Time	300	seconds
SNTP Server Retries	2	
SNTP Server Timeout	3	seconds
SNTP Poll Interval	3600	seconds
SNTP Server 1		
SNTP Server Status	02-Sep-2011 09:22:24: OK.	
SNTP Server IP Address	10 . 130 . 1 . 205	
SNTP Server Port Number	123	
SNTP Server Authentication Protocol	◉ None ○ DES	
SNTP Server Key Identifier	1	
Server Key	••••••••••••••••	
Server Key Confirm	••••••••••••••••	
SNTP Server 2		
SNTP Server Status	Server not yet used	
SNTP Server IP Address	0 . 0 . 0 . 0	
SNTP Server Port Number	123	
SNTP Server Authentication Protocol	◉ None ○ DES	
SNTP Server Key Identifier	1	
Server Key	••••••••••••••••	
Server Key Confirm	••••••••••••••••	
Status		
SNTP Sync	In Sync	
SNTP Last Sync	02-Sep-2011 09:22:24	
System Clock	02-Sep-2011 09:46:56	
Local Time Settings		
Time Zone	GMT 00.00	
Daylight Saving	◉ Disabled ○ Enabled	

Submit Updated Configuration | Reset Form

Table 129 SNTP clock attributes

Attribute	Meaning
SNTP State	'Enabled' means that the ODU will obtain accurate date and time updates from a networked time server.
SNTP Primary Server	Specifies the primary SNTP server, determining the order in which the servers are tried.
SNTP Primary Server Dead Time	Time (in seconds) to wait before retrying communications with an unresponsive primary SNTP server. Setting the value to zero disables the timer.
SNTP Server Retries	Number of times the PTP will retry after an SNTP server fails to respond.
SNTP Server Timeout	Time (in seconds) the PTP will wait for a response from an SNTP server.
SNTP Poll Interval	The SNTP server polling interval.
SNTP Server 1 and 2:	
SNTP Server Status	Status message reflecting the state of communications with the SNTP server.
SNTP Server IP Address	Enter the IP address of the networked SNTP server.
SNTP Server Port Number	Enter the port number of the networked SNTP server. By convention the default value for the port number is 123.
SNTP Server Authentication Protocol	Authentication protocol to be used with this SNTP server (None or DES).
SNTP Server Key Identifier	SNTP key identifier. A key of zeros is reserved for testing.
Server Key	Key used to authenticate SNTP communications. For DES keys this must be 16 hexadecimal characters as per the DES specification, with the least significant bit of each pair used to maintain odd parity.
Server Key Confirm	Must match the Server Key.
Status:	

Attribute	Meaning
SNTP Sync	This shows the current status of SNTP synchronization. If 'No Sync' is displayed, then review the SNTP Server IP Address and Port Number. A change of state may generate an SNMP trap or SMTP email alert.
SNTP Last Sync	This shows the date and time of the last SNTP synchronization.
System Clock	This displays the local time, allowing for the Time Zone and Daylight Saving settings.
Local Time Settings:	
Time Zone	Set the time zone offset from Greenwich Mean Time (GMT). To set the clock to UTC time, set Time Zone to 'GMT 00.00'.
Daylight Saving	'Disabled' means that daylight saving adjustments will not be applied to the time. 'Enabled' means that daylight saving adjustments will be applied to the time, according to local rules. To set the clock to UTC time, set Daylight Saving to 'Disabled'.

Task 16: Configuring the fiber interface

This task is only performed when a fiber optic Ethernet interface is installed.

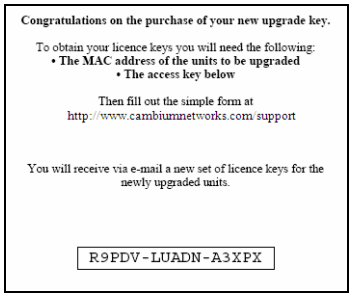
This task consists of the following procedures:

- Obtaining the license key for Ethernet fiber support on page 6-105
- Connecting to the unit and checking for fiber support on page 6-105
- Entering the license key for Ethernet fiber support on page 6-106
- Connecting to the fiber network on page 6-107
- Configuring SFP on page 6-109

Obtaining the license key for Ethernet fiber support

Before the fiber interface can be enabled, a new license key must be installed in the PTP 600 unit. Instructions on how to obtain the license key and a unique ID code are provided in a sealed envelope in the “PTP 600 Series Bridge Optical Interface Upgrade Kit” (Figure 153).

Figure 153 Fiber license key instructions


Congratulations on the purchase of your new upgrade key.
To obtain your licence keys you will need the following:
• The MAC address of the units to be upgraded
• The access key below
Then fill out the simple form at
http://www.cambiumnetworks.com/support
You will receive via e-mail a new set of licence keys for the newly upgraded units.
R9PDV-LUADN-A3XPX

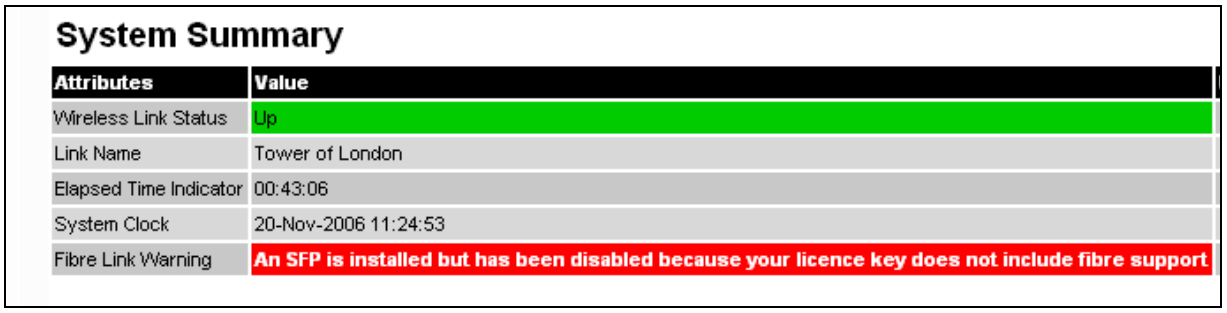
The new license key is specific to a single wireless unit. Prior to installation, obtain the license key from the Cambium website.

Connecting to the unit and checking for fiber support

Connect the management PC to the PTP 600 unit, power up and log into the web interface as described in Task 1: Connecting to the unit on page 6-3.

If the SFP fiber module has already been installed, an alarm is displayed on the System Summary page to indicate that an SFP module has been detected but the current license key does not include fiber support (Figure 154).

Figure 154 Fiber license key alarm

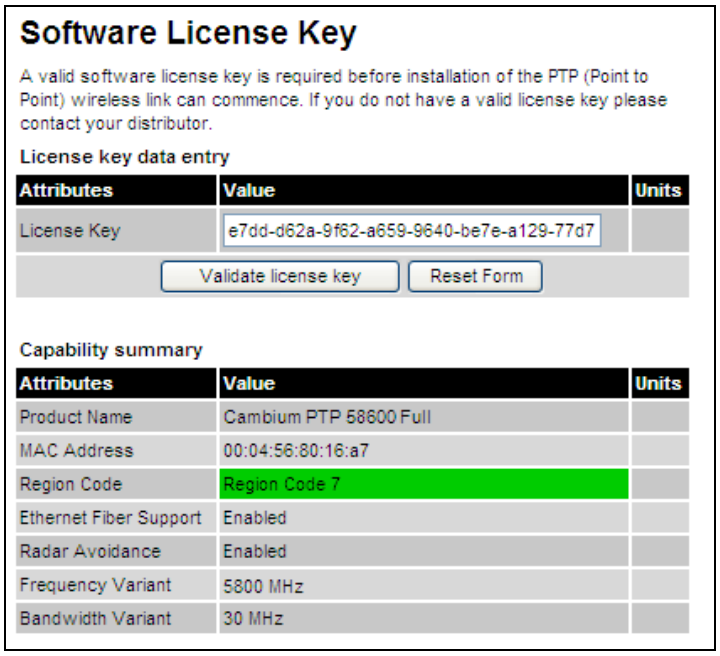


The absence of this alarm indicates either that the SFP module is not connected correctly, or that the current license key already includes fiber support.

Entering the license key for Ethernet fiber support

Select menu option **System, License Key** (enter a userid and password, if requested). The Software License Key page is displayed. If the 'Capability summary' table includes the attribute 'Ethernet Fiber Support' then the unit already supports fiber connection (Figure 155).

Figure 155 Ethernet fiber support enabled



If the attribute 'Ethernet Fiber Support' is not present, then it will be necessary to install the new license key. Proceed as follows:

1. Make a note of the current license key, as it may be needed to reset the wireless unit to its current configuration.

2. Enter the new license key exactly as it is written in the email sent as a result of registering the unique ID code and MAC address on the Cambium website.
3. Select Validate license key.
4. If the message "ERROR Invalid License Key" is displayed, then use the back button and re-enter the license key string. If this is still rejected, then contact Cambium support.
5. If the license key is accepted, a prompt to reboot the wireless unit is displayed. Select **Reboot Wireless Unit** and **OK** to confirm the reboot.

Connecting to the fiber network

When the unit has rebooted, check the System Summary page. The SFP alarm described in Connecting to the unit and checking for fiber support on page 6-105 should no longer be displayed.

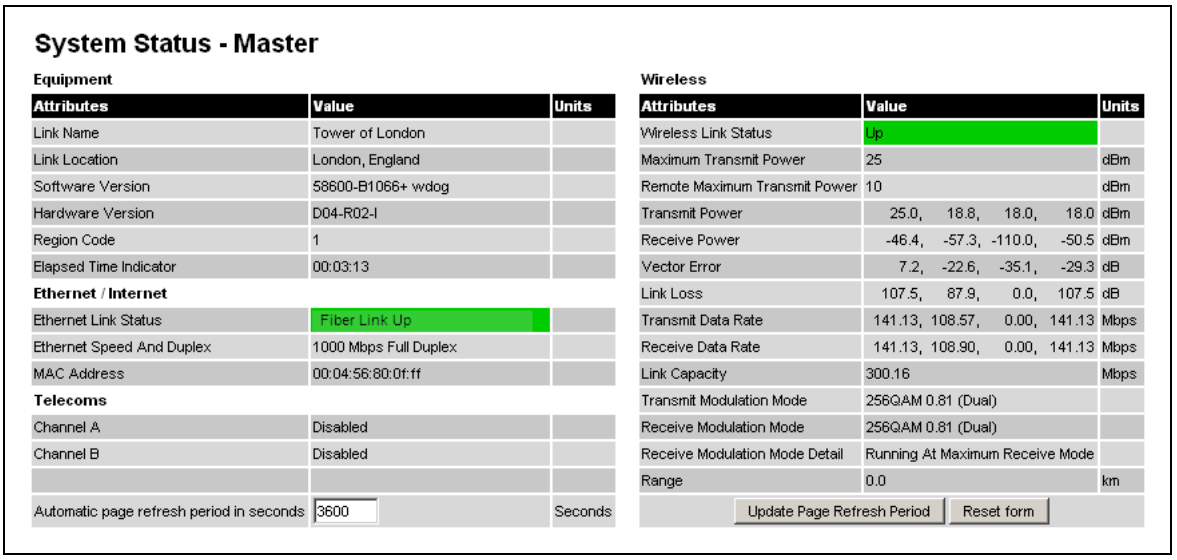
Disconnect the Cat5e cable from the PIDU+ port of the ODU. Connect the fiber optic cable from the ODU to the network.

⚠ CAUTION

If the fiber interface becomes active, the PTP 600 unit will automatically switch to the fiber interface and will no longer communicate over the copper interface.

Connect the management PC to the network and log into the ODU. Select menu option **Status** and confirm that the Ethernet Link Status attribute is set to 'Fiber Link Up' (Figure 156).

Figure 156 Ethernet fiber link enabled



System Status - Master

Equipment

Attributes	Value	Units
Link Name	Tower of London	
Link Location	London, England	
Software Version	58600-B1066+ wdog	
Hardware Version	D04-R02-I	
Region Code	1	
Elapsed Time Indicator	00:03:13	
Ethernet / Internet		
Ethernet Link Status	Fiber Link Up	
Ethernet Speed And Duplex	1000 Mbps Full Duplex	
MAC Address	00:04:56:80:0f:ff	
Telecoms		
Channel A	Disabled	
Channel B	Disabled	
Automatic page refresh period in seconds	3600	Seconds

Wireless

Attributes	Value	Units
Wireless Link Status	Up	
Maximum Transmit Power	25	dBm
Remote Maximum Transmit Power	10	dBm
Transmit Power	25.0, 18.8, 18.0, 18.0	dBm
Receive Power	-46.4, -57.3, -110.0, -50.5	dBm
Vector Error	7.2, -22.6, -35.1, -29.3	dB
Link Loss	107.5, 87.9, 0.0, 107.5	dB
Transmit Data Rate	141.13, 108.57, 0.00, 141.13	Mbps
Receive Data Rate	141.13, 108.90, 0.00, 141.13	Mbps
Link Capacity	300.16	Mbps
Transmit Modulation Mode	256QAM 0.81 (Dual)	
Receive Modulation Mode	256QAM 0.81 (Dual)	
Receive Modulation Mode Detail	Running At Maximum Receive Mode	
Range	0.0	km

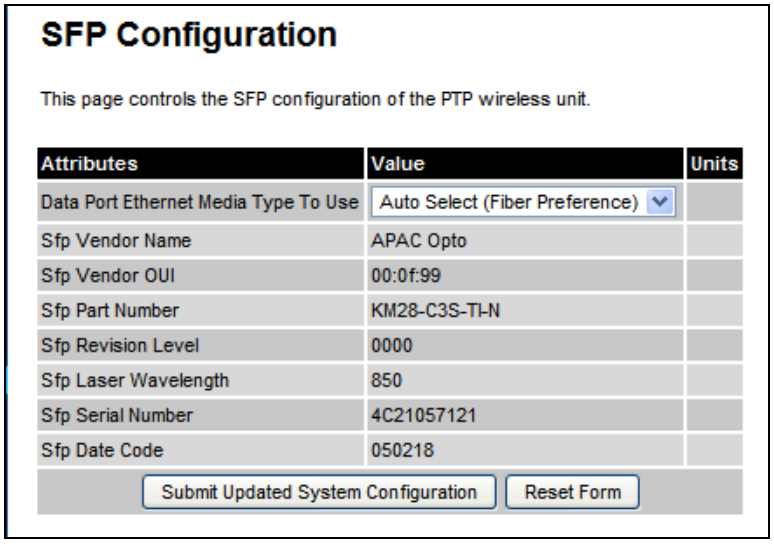
Update Page Refresh Period | Reset form

Configuring SFP

Select menu option **System, SFP Configuration**. The SFP Configuration page is displayed (Figure 157).

> **NOTE**
> If the SFP fiber module is not automatically sensed by the PTP 600 unit, the **SFP Configuration** menu option will not be available.

Figure 157 SFP Configuration page



This page contains a single user selectable attribute 'Data Port Ethernet Media Type To Use'. This attribute has three options:

- 'Auto Select (Fiber Preference)' means that if a supported SFP module is present and is working, and the fiber carrier is present, the Ethernet service connects through fiber and the copper data port is not used. If the fiber link fails or loses the carrier signal, the Ethernet service falls back to the copper LAN connection.
- 'Copper Media Only' means that the Ethernet service connects through the copper port only and the Fiber SFP interface is disabled.
- 'Fiber Media Only' means that the Ethernet service connects through the Fiber SFP interface only and the copper port is disabled.

The remaining attributes contain information read from the SFP fiber module.

Task 17: Saving the system configuration

Save the system configuration in the following situations:

- After a new unit has been fully configured as described in this chapter.
- After any change has been made to the configuration.
- Before upgrading the unit to a new software version.
- After upgrading the unit to a new software version.

> **NOTE**
> The process for restoring a unit to a previously saved configuration is described in Restoring the system configuration on page 7-48.

Saving the system configuration

To save the current configuration, select menu option **System, Configuration**, **Save And Restore**. The Save & Restore Configuration page is displayed (Figure 158). Select **Save Configuration File** and save the configuration file to a PC hard drive.

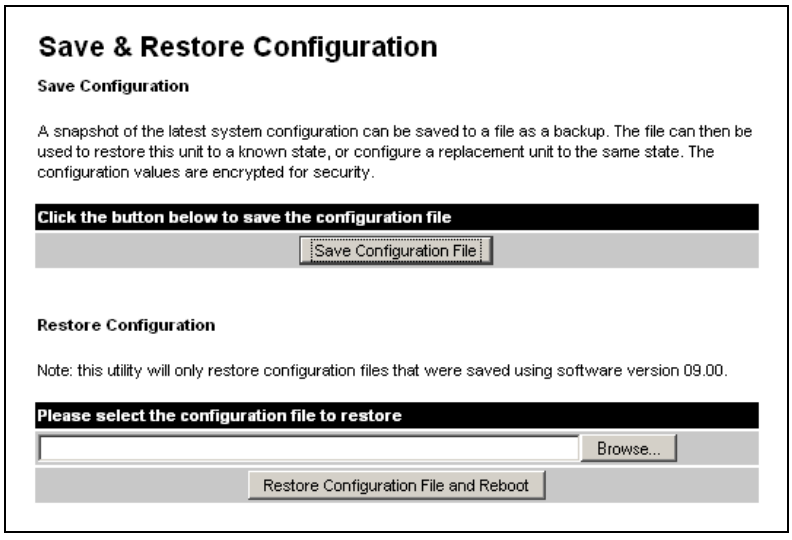
The configuration file format is:

MAC-mm-mm-mm_IP-iii-iii-iii-iii.cfg

Where: mm-mm-mm **Is:** MAC address of unit

iii-iii-iii-iii IP address of unit.

Figure 158 Save & Restore Configuration page


Save & Restore Configuration
Save Configuration
A snapshot of the latest system configuration can be saved to a file as a backup. The file can then be used to restore this unit to a known state, or configure a replacement unit to the same state. The configuration values are encrypted for security.
Click the button below to save the configuration file
Save Configuration File
Restore Configuration
Note: this utility will only restore configuration files that were saved using software version 09.00.
Please select the configuration file to restore
Browse...
Restore Configuration File and Reboot

Configuring for FIPS 140-2 applications

This is a summary of all the configuration tasks that are necessary if the unit is to operate in FIPS 140-2 secure mode. For more information, refer to FIPS 140-2 mode on page 1-60 and Planning for FIPS 140-2 operation on page 2-42.

Prerequisites for FIPS 140-2 configuration

To confirm that all prerequisites for FIPS 140-2 are ready, proceed as follows:

1. Ensure that the following cryptographic material has been generated using a FIPS-approved cryptographic generator:

   Key Of Keys

   TLS Private Key and Public Certificates (for the correct IP address)

   Entropy Input

   Wireless Link Encryption Key for AES

2. Identify the Port number for HTTPS.
3. Ensure that the web browsers used are enabled for HTTPS/TLS operation using FIPS-approved cipher specifications.
4. Select menu option **Management, Web, Local User Accounts** and check that the current user's role is Security Officer.
5. Perform Task 3: Installing license keys on page 6-14 and ensure that the installed license key meets all requirements including FIPS 140-2 compatibility:

   Check that Security Level is ‘FIPS’.

   Check that Encryption Algorithm is ‘AES….’.

   If necessary, generate and enter a new license key with the above settings.

6. Perform Task 4: Upgrading software version on page 6-17 and ensure that the installed software version is prefixed `FIPS-`. If necessary, upgrade to the latest FIPS validated image.
7. To confirm that the above steps have been completed, check that the ‘FIPS 140-2 Validated’ logo is displayed in the Navigation Bar:

Configuration procedures for FIPS 140-2

To activate FIPS 140-2 secure mode:

- Perform Using the Security Wizard on page 6-24.
- Perform Configuring local user accounts on page 6-34, taking care to complete the following additional settings:
  - Select **Set Best Practice Complexity**.
  - Configure appropriate identity-based user names and passwords.

Checking that the unit is in FIPS 140-2 secure mode

To confirm that the unit is now in FIPS 140-2 secure mode, proceed as follows:

1. Select menu option **Security** and check the Secure Mode Alarm value.
2. If the alarm is 'Secure mode is active', the unit is in FIPS 140-2 secure mode and no further action is needed.

3. If the alarm is 'Secure mode is not configured', return to Using the Security Wizard on page 6-24 and check that all Security Wizard settings are correct for FIPS 140-2.

   If this alarm is extant, it is also displayed in the System Summary page.

4. If the alarm is 'Secure mode is configured, but not active', return to Step 7: HTTP and Telnet settings on page 6-31 and check that HTTP Access Enabled is set to 'No'.

   If this alarm is extant, it is also displayed in the System Summary page.

NOTE

If it is necessary to exit from FIPS 140-2 mode, refer to Exiting FIPS 140-2 or UC APL mode on page 7-34.

HTTPS key size warning

If the HTTPS key size warning alarm (Figure 159) is present in the Home page, no immediate action is necessary, as this alarm does not block the transition to FIPS 140-2 secure mode. This alarm is produced because FIPS 140-2 recommends a TLS Private Key of at least 2048 bits, but a 1024 bit key has been entered. To clear this alarm, generate a new TLS certificate with key length of at least 2048 bits, then return to Step 2: TLS private key and public certificate on page 6-27.

Figure 159 HTTPS key size warning alarm

Configuring for UC APL applications

This is a summary of all the configuration tasks that are necessary if the unit is to operate in UC APL secure mode. For more information on UC APL secure mode, refer to Unified Capabilities Approved Product (UC APL) mode on page 1-65 and Planning for UC APL operation on page 2-43.

Prerequisites for UC APL configuration

To confirm that all prerequisites for UC APL are ready, proceed as follows:

1. Ensure that the following cryptographic material has been generated using a FIPS-approved cryptographic generator:

   Key Of Keys.

   TLS Private Key and Public Certificates (for the correct IP address): these should be encoded in DER format; DES keys are required for NTP; maximum key size is 2048 bits.

   Entropy Input.

   Wireless Link Encryption Key for AES.

2. Obtain the following details:

   Port number for HTTPS.

   AAA server configuration details.

   Syslog server details.

   Authenticated NTP key material.

   Approved security banner text.

   DoD password complexity rules.

   IP address of the CAC-enabled management workstation.

3. Ensure that the web browsers used are enabled for HTTPS/TLS operation using FIPS-approved cipher specifications.

4. Select menu option **Management, Web, Local User Accounts** and check that the current user's role is Security Officer.

5 Perform Task 3: Installing license keys on page 6-14 and ensure that the installed license key meets all requirements including UC APL compatibility:

Check that Security Level is ‘UC-APL’.

Check that Encryption Algorithm is ‘AES….’.

If necessary, generate and enter a new license key with the above settings.

6 Perform Task 4: Upgrading software version on page 6-17 and ensure that the installed software version is prefixed `UC_APL-`. If necessary, upgrade to the latest UC APL validated image.

7 To confirm that the above steps have been completed, check that the ‘UC-APL Validated’ logo is displayed in the Navigation Bar:

Configuration procedures for UC APL

To activate UC APL secure mode, proceed as follows:

1 Perform Using the Security Wizard on page 6-24, taking care to complete the following additional settings:

In Step 3, set Require Acknowledgement of Notices to ‘Yes’.

In Step 3, enter the standard security banner text defined for U.S. Government Information Systems. The text reproduced in Security banner text for UC APL on page 6-117 is valid at the date of publication of this User Guide.

In Step 4, set Display Login Information to ‘Yes’.

2 Perform Configuring web-based management attributes on page 6-83, taking care to complete the following additional settings:

a. Set Access Control to ‘Enabled’.

b. Enter the IP address of the CAC-enabled workstation as the Access Control IP Address.

3 Perform either Configuring SNMPv3 agent on page 6-63 or Configuring SNMPv1/2c agent on page 6-72, taking care to complete the following additional settings:

In Step 1, set SMP Access Control to ‘Enabled’.

In Step 1, enter up to three SNMP Access Control IP Address.

4 Perform Configuring local user accounts on page 6-34, taking care to complete the following additional settings:

a. Configure password complexity as required by the latest version of the *Application and Security Development STIG*.

b. Configure appropriate identity-based user names and passwords, taking care to select Force Password Change for all users apart from the current user.

5 Perform Configuring RADIUS authentication on page 6-42, taking care to complete the following additional settings:

Set RADIUS Client to ‘Enabled’.

Set Authentication Method to ‘PEAP(MS-CHAPv2).

Configure one or two authentication servers by entering their IP addresses and other attributes.

6 Perform Setting the real-time clock to synchronize using SNTP on page 6-101, taking care to complete the following additional settings:

Set SNTP State to ‘Enabled’.

Configure one or two SNTP servers by entering their IP addresses and other attributes; set SNTP Server Authentication Protocol to ‘DES’ or ‘MD5’ and enter SNTP Server Key Identifier and Server Key to match the security settings of the SNTP servers.

Set Time Zone to ‘GMT 00.00’.

Set Daylight Saving to ‘Disabled’.

7 Perform Configuring system logging (syslog) on page 6-81, taking care to complete the following additional settings:

Set Syslog State to ‘Enabled’.

Set Syslog Client to ‘Enabled’.

Configure one or two syslog servers by entering their IP addresses and other attributes.

Security banner text for UC APL

This is the text for the security banner for UC APL, to be entered in Step 3 of the Security Wizard:

> You are accessing a U.S. Government (USG) Information System (IS) that is provided for USG-authorized use only. By using this IS (which includes any device attached to this IS), you consent to the following conditions:
>
> - The USG routinely intercepts and monitors communications on this IS for purposes including, but not limited to, penetration testing, COMSEC monitoring, network operations and defense, personnel misconduct (PM), law enforcement (LE), and counterintelligence (CI) investigations.
>
> - At any time, the USG may inspect and seize data stored on this IS.
>
> - Communications using, or data stored on, this IS are not private, are subject to routine monitoring, interception, and search, and may be disclosed or used for any USG-authorized purpose.
>
> - This IS includes security measures (e.g., authentication and access controls) to protect USG interests - not for your personal benefit or privacy.
>
> - Notwithstanding the above, using this IS does not constitute consent to PM, LE or CI investigative searching or monitoring of the content of privileged communications, or work product, related to personal representation or services by attorneys, psychotherapists, or clergy, and their assistants. Such communications and work product are private and confidential. See User Agreement for details.

NOTE

The above text is valid at the date of publication of this User Guide. Check for the latest DISA-approved version of this text.

Checking that the unit is in UC APL secure mode

To confirm that the unit is now in UC APL secure mode, proceed as follows:

1. Select menu option **Security** and check the Secure Mode Alarm value.
2. If the alarm is ‘Secure mode is active’, the unit is in UC APL secure mode and no further action is needed.

3 If the alarm is ‘Secure mode is not configured’, return to Using the Security Wizard on page 6-24 and check that all Security Wizard settings are correct for UC APL.

If this alarm is extant, it is also displayed in the System Summary page.

4 If the alarm is ‘Secure mode is configured, but not active’, return to Step 7: HTTP and Telnet settings on page 6-31 and check that HTTP Access Enabled is set to ‘No’.

If this alarm is extant, it is also displayed in the System Summary page.

NOTE

If it is necessary to exit from UC APL mode, refer to Exiting FIPS 140-2 or UC APL mode on page 7-34.

HTTPS key size warning

If the HTTPS key size warning alarm is present in the Home page:

no immediate action is necessary, as this alarm does not block the transition to UC APL secure mode. This alarm is produced because FIPS140-2 (reference SP 800-131A) recommends a TLS Private Key of at least 2048 bits, but a 1024 bit key has been entered. To clear this alarm, generate a new TLS certificate with key length of at least 2048 bits, then return to Step 2: TLS private key and public certificate on page 6-27.

Chapter 7: Operation

This chapter provides instructions for operators of the PTP 600 web user interface.

The following topics are described in this chapter:

- Web-based management on page 7-2
- Managing alarms and events on page 7-14
- Managing spectrum on page 7-20
- Managing security on page 7-34
- Managing performance on page 7-35
- Restoring, upgrading and rebooting on page 7-48
- Using recovery mode on page 7-53.

Web-based management

This section describes the layout and the main menu options of the PTP 600 web-based management interface. The following topics are covered:

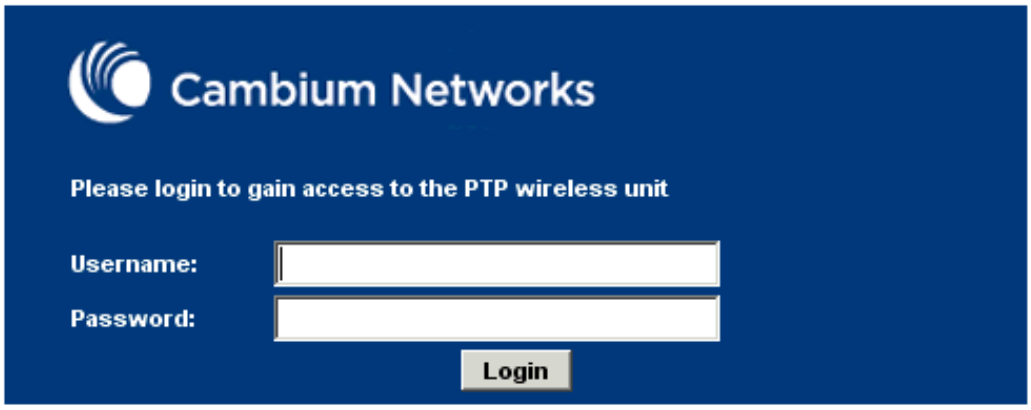
- Accessing the web interface on page 7-2
- Using the menu options on page 7-3
- Viewing the system summary on page 7-5
- Viewing the system status on page 7-6

Accessing the web interface

The web interface is best viewed using a screen resolution of at least 1024 x 768 pixels. The web pages have been tested with Internet Explorer 7, Internet Explorer 8, Firefox 3 and Firefox 3.5. Other browsers have not been tested.

To access the web interface, type the IP address of the unit into the browser address bar and press ENTER. The login page is displayed (Figure 160). Enter Username (if requested) and Password (if set) and select **Login**.

Figure 160 Login page (with username)



Using the menu options

All web pages contain the menu navigation bar on the left hand side. The menu is used to navigate to other web pages. The currently selected option is always highlighted with a light blue background.

Table 130 lists the procedures that may be performed from each menu option. Many of these procedures are part of the initial configuration and alignment process described in Chapter 6: Configuration and alignment.

Table 130 Procedures performed from each menu option

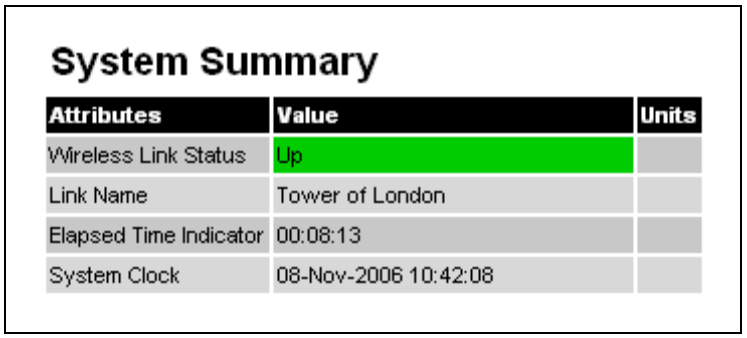
Menu option	Procedures
Home	Viewing the system summary on page 7-5 Checking that the units are armed on page 6-85
Status	Viewing the system status on page 7-6 Checking the installed software version on page 6-17
« System	
« Configuration	Reviewing system configuration attributes on page 6-92 Configuring AES encryption on page 6-22
LAN Configuration	Configuring the IP interface and management mode on page 6-7
QoS Configuration	Configuring quality of service on page 6-96
SFP Configuration	Configuring SFP on page 6-109
Telecoms	Performing a telecoms loopback test on page 8-16
Save And Restore	Saving the system configuration on page 6-110 Restoring the system configuration on page 7-48
Spectrum Management	Configuring spectrum usage at the master on page 7-20 Viewing spectrum usage at the slave on page 7-23 Barring channels on page 6-62
« Statistics	Checking system statistics on page 7-35 Comparing actual to predicted performance on page 6-95
Detailed Counters	Checking detailed counters on page 7-41 Test Ethernet packet errors reported by ODU on page 8-7
« Diagnostics Plotter	Using the diagnostics plotter on page 7-45
CSV Download	Downloading diagnostic data on page 7-46

Menu option	Procedures
License Key	Checking licensed capabilities on page 6-14 Entering a new license key on page 6-16
Software Upgrade	Upgrading to a new software version on page 6-18
Reboot	Rebooting or reviewing reboot reasons on page 7-52
« Installation	Starting installation wizard on page 6-45 Disarming the units on page 6-91
Graphical Install	Method #2: graphical install on page 6-90
« Management	
« Web	Configuring web-based management attributes on page 6-83
Local User Accounts	Configuring local user accounts on page 6-34 Setting password complexity on page 6-37 Creating or updating identity-based users on page 6-39
RADIUS Configuration	Configuring RADIUS authentication on page 6-42
Web Properties	Protecting access to the summary and status pages on page 6-41 Checking system statistics on page 7-35
SNMP	Configuring SNMPv3 agent on page 6-63 Configuring SNMPv1/2c agent on page 6-72
Email	Configuring generation of email messages on page 6-79
Diagnostic Alarms	Configuring generation of diagnostics alarms on page 6-77
Time	Setting the real-time clock on page 6-100
« Syslog	Managing event notification messages on page 7-19
Syslog Configuration	Configuring system logging (syslog) on page 6-81
« Security	Configuring HTTPS/TLS on page 6-23
Zeroize CSPs	Zeroizing critical security parameters on page 7-34
Change Password	Changing own user password on page 6-41
Logout	

Viewing the system summary

To display the System Summary page, select menu option **Home**. The System Summary page (Figure 161) contains a high level summary of the status of the wireless link and associated equipment.

Figure 161 System Summary page



The System Summary page displays any uncleared system alarms below the System Clock attribute. Whenever system alarms are outstanding, a yellow warning triangle is displayed on the navigation bar. For more information, refer to Managing alarms on page 7-14.

The attributes of the System Summary page are described in Table 131.

Table 131 System Summary attributes

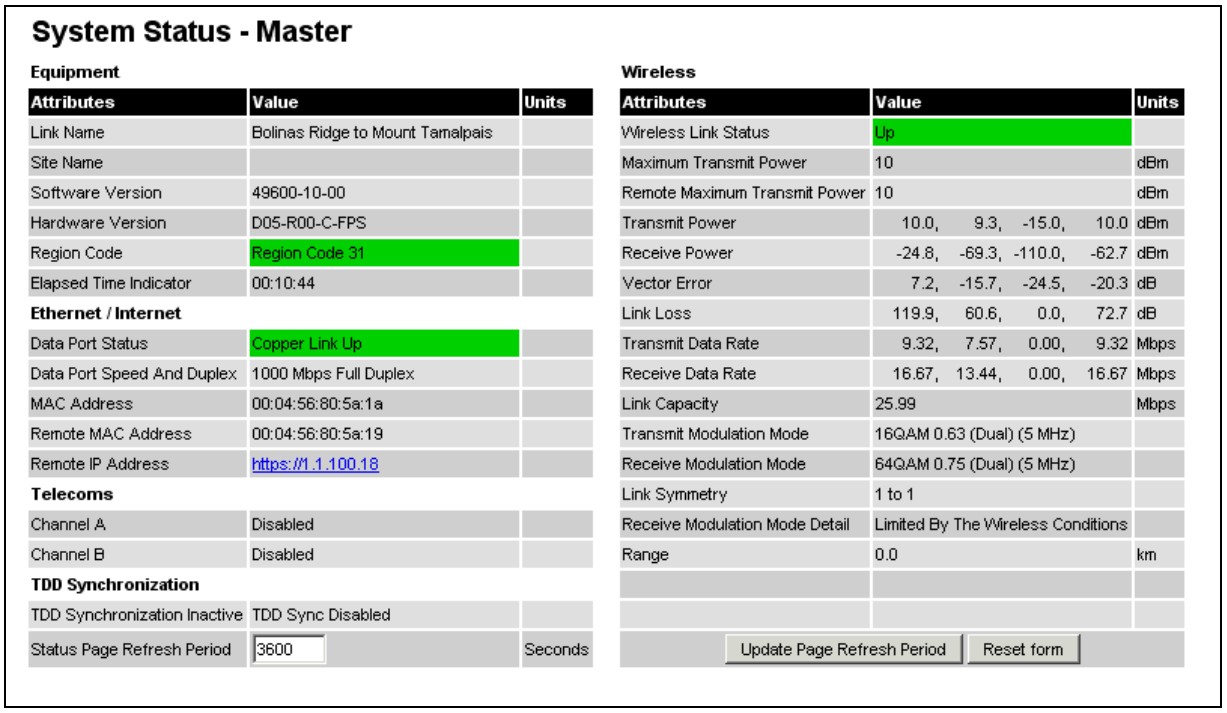
Attribute	Meaning
Wireless Link Status	Current status of the wireless link. A green background with status text 'Up' means that the point-to-point link is established. A red background with suitable status text (for example 'Searching') indicates that the link is not established.
Link Name	The name of the PTP link, as set in the System Configuration page.
Elapsed Time Indicator	The time (hh:mm:ss) that has elapsed since the last system reboot. The system can reboot for several reasons, for example, commanded reboot from the system reboot webpage, or a power cycle of the equipment.
System Clock	The system clock presented as local time, allowing for zone and daylight saving.

Viewing the system status

To display the System Status page, select menu option **Status**.

The System Status page (Figure 162) gives the user a detailed view of the operation of the PTP 600 Series from both the wireless and network perspectives.

Figure 162 System Status page



System Status - Master

Equipment

Attributes	Value	Units
Link Name	Bolinas Ridge to Mount Tamalpais	
Site Name		
Software Version	49600-10-00	
Hardware Version	D05-R00-C-FPS	
Region Code	Region Code 31	
Elapsed Time Indicator	00:10:44	
Ethernet / Internet		
Data Port Status	Copper Link Up	
Data Port Speed And Duplex	1000 Mbps Full Duplex	
MAC Address	00:04:56:80:5a:1a	
Remote MAC Address	00:04:56:80:5a:19	
Remote IP Address	https://1.1.100.18	
Telecoms		
Channel A	Disabled	
Channel B	Disabled	
TDD Synchronization		
TDD Synchronization Inactive	TDD Sync Disabled	
Status Page Refresh Period	3600	Seconds

Wireless

Attributes	Value	Units
Wireless Link Status	Up	
Maximum Transmit Power	10	dBm
Remote Maximum Transmit Power	10	dBm
Transmit Power	10.0, 9.3, -15.0, 10.0	dBm
Receive Power	-24.8, -69.3, -110.0, -62.7	dBm
Vector Error	7.2, -15.7, -24.5, -20.3	dB
Link Loss	119.9, 60.6, 0.0, 72.7	dB
Transmit Data Rate	9.32, 7.57, 0.00, 9.32	Mbps
Receive Data Rate	16.67, 13.44, 0.00, 16.67	Mbps
Link Capacity	25.99	Mbps
Transmit Modulation Mode	16QAM 0.63 (Dual) (5 MHz)	
Receive Modulation Mode	64QAM 0.75 (Dual) (5 MHz)	
Link Symmetry	1 to 1	
Receive Modulation Mode Detail	Limited By The Wireless Conditions	
Range	0.0	km

Update Page Refresh Period | Reset form

The page is subdivided into five categories:

- **Equipment**: This contains the unit's inventory and identification information.
- **Wireless**: This presents the key wireless metrics, which are displayed as a series of measurements.
- **Ethernet/Internet**: This describes the unit's network identity and connectivity.
- **Telecoms**: This describes the unit's E1/T1 telecoms interface parameters.
- **TDD Synchronization**: This shows the status of TDD synchronization.

The status page can be configured to refresh itself at an operator defined rate (if the user is logged in as system administrator). The refresh period defaults to 3600 seconds and can easily be changed to refresh at any period between 2 seconds and 3600 seconds. Pressing the **Update Page Refresh Period** button causes a new page refresh period to be adopted by the system. The page refresh mechanism uses a HTML Meta refresh command. Therefore the refresh is always initiated by the local browser and not by the PTP 600 Series at this interval.

The two PTP 600 Series units are arranged in a master and slave relationship. The roles of the units in this relationship are displayed in the page title. The master unit will always have the title '- Master', and the slave will always have '- Slave' appended to the 'Systems Status' page title.

The status page attributes are defined in Table 132..

Table 132 System Status attributes

Attribute	Meaning
Link Name	The link name is allocated by the system administrator and is used to identify the equipment on the network. The link name attribute is limited to a maximum size of 63 ASCII characters.
Site Name	The site name is allocated by the system administrator and can be used as a generic scratch pad to describe the location of the equipment or any other equipment related notes. The site name attribute is limited to a maximum size of 63 ASCII characters.
Software Version	The attribute describes the version of software installed on the equipment. The format of the attributes is *FFSSS*-XX-*YY* where *FF* is the frequency variant (2.5, 4.5, 5.4, 5.8 or 5.9 GHz), *SSS* is the System Release, *XX* is the major release version and *YY* is the minor release version.
Hardware Version	The hardware version attribute contains all the combined hardware version information. The attribute is formatted as *Dxx-Ryy-z* where *Dxx* contain the version of the digital card, *Ryy* contains the version of the RF (radio frequency) card and *z* describes the antenna type which can be I (integrated) or C (connectorized).
Region Code	The region code is used by the system to constrain the wireless to operate within regulatory regime of the particular country. The region code is encoded in the product license key. If the operator wishes to change region code, a new license key must be obtained from Cambium or the local point-to-point distributor or system integrator.
Elapsed Time Indicator	The elapsed time indicator attribute presents the total time in years, days, hours, minutes and seconds since the last system restart. The system can restart for several reasons, for example commanded reboot from the system reboot web page, or a power cycle of the equipment.
Ethernet Link Status	This indicates the current status of the Ethernet link. A state of 'Up' with a green background indicates that an Ethernet link is established. A state of 'Down' with a red background indicates that the Ethernet link is not established.

Attribute	Meaning
Ethernet Speed and Duplex	The negotiated speed and duplex setting of the Ethernet interface. The speed setting is specified in Mbps. Full Duplex data transmission means that data can be transmitted in both directions on a signal carrier at the same time. For example, on a local area network with a technology that has full duplex transmission; one workstation can be sending data on the line while another workstation is receiving data. Half Duplex data transmission means that data can be transmitted in both directions on a signal carrier, but not at the same time. For example, on a local area network using a technology that has half duplex transmission, one workstation can send data on the line and then immediately receive data on the line from the same direction in which data was just transmitted.
Remote IP Address	Hyperlink to the other side of the Link. The IP address of the peer link is displayed if the Link is UP, otherwise ‘unavailable’ is displayed.

Attribute	Meaning
Telecoms Channel A and B	Indicate the current status of the telecoms channels. Channels which are disabled during installation are marked as such. Correctly operating channels display "Up" on a green background, but alarm conditions (described in Managing alarms on page 7-14) have a red background. The Telecoms Latency value, displayed in microseconds, is determined when the wireless link starts and will remain the same for a given wireless configuration. Section Telecoms circuits on page 1-46 describes methods for reducing telecoms latency on links which support high data rate modulation modes. Under normal circumstances the unit will freely transition between modulation modes to suit the wireless conditions. The "Single Payload Lock" indicates that the ODU will prevent transitions from Single Payload modes to the higher Dual Payload modes in order to avoid loss of telecoms data. This field appears where such a transition would pass through modes which cannot carry telecoms data. This may be because, in order to control latency, the lowest modulation mode has been set to a higher Single Payload mode. In the absence of the Single Payload Lock the wireless will transition to the faster Dual Payload modes as soon as the conditions are appropriate. With the lock enabled, the wireless will dwell in slower Single Payload modes whenever there are operational telecoms links (operational links are shown as "Up" in the telecoms channel field described above). When the lock is actively preventing transitions, the value displayed changes from "Enabled" to "Applied".
TDD Synchronization	Displays the TDD Synchronization status for the link. For more information, refer to TDD synchronization status on page 7-12.
Refresh Page Period	The Status page refreshes automatically according to the setting entered here (in seconds). This attribute is only displayed when the user is logged on as System Administrator.
Wireless Link Status	As the attribute name suggests it displays the current status of the wireless link. A state of ‘Up’ on a green background indicates that a point-to-point link is established. A state of ‘Down’ on a red background indicates that the wireless link is not established.
Maximum Transmit Power	The maximum transmit power that the local wireless unit is permitted to use to sustain a link.
Remote Maximum Transmit Power	The maximum transmit power that the remote wireless unit is permitted to use to sustain a link.

Attribute	Meaning
Transmit Power	The maximum, mean, minimum and latest measurements of Transmit Power (dBm). See Diagnostics calculated over time on page 7-47.
Receive Power	The maximum, mean, minimum and latest measurements of Receive Power (dBm). See Diagnostics calculated over time on page 7-47.
Vector Error	The maximum, mean, minimum and latest measurements of Vector Error (dB). See Diagnostics calculated over time on page 7-47. Vector Error compares the received signal's In phase / Quadrature (IQ) modulation characteristics to an ideal signal to determine the composite error vector magnitude. The expected range for Vector Error is approximately -2 dB (NLOS link operating at sensitivity limit on BPSK 0.67) to -33 dB (short LOS link running 256 QAM 0.83).
Link Loss	The maximum, mean, minimum and latest measurements of Link Loss (dB). See Diagnostics calculated over time on page 7-47. The link loss is the total attenuation of the wireless signal between the two point-to-point units. The link loss calculation is presented below: $P_{ll} = P_{T_x} - P_{R_x} + g_{T_x} + g_{R_x}$ Where: P_{ll} = Link Loss (dB) P_{T_x} = Transmit power of the remote wireless unit (dBm) P_{R_x} = Received signal power at the local unit (dBm) g_{T_x}, g_{R_x} = Antenna gain at the remote and local units respectively (dBi). The antenna gain of the PTP 600 Series (23.5 dBi) is used unless one or both of the units is a Connectorized version. For connectorized ODUs, the link loss calculation is modified to allow for the increased antenna gains at each end of the link.
Transmit Data Rate	The maximum, mean, minimum and latest measurements of Transmit Data Rate (Mbps). See Diagnostics calculated over time on page 7-47. Expected data rates can be found in Data throughput tables on page 4-74.

Attribute	Meaning
Receive Data Rate	The maximum, mean, minimum and latest measurements of Receive Data Rate (Mbps). See Diagnostics calculated over time on page 7-47. Expected data rates can be found in Data throughput tables on page 4-74.
Link Capacity	The maximum aggregate data rate capacity available for user traffic, assuming the units have been connected using Gigabit Ethernet. The link capacity is variable and depends on the prevailing wireless conditions as well as the distance (range) between the two wireless units.
Transmit Modulation Mode	The modulation mode currently being used on the transmit channel. A list of all the modulation modes can be found in Data throughput tables on page 4-74, where data rate calculations plots are given for each available modulation mode.
Receive Modulation Mode	The modulation mode currently being used on the receive channel. A list of all the modulation modes can be found in Data throughput tables on page 4-74, where data rate calculations plots are given for each available modulation mode.
Link Symmetry	A ratio that expresses the division between transmit and receive time in the TDD frame. The first number in the ratio represents the time allowed for the transmit direction and the second number represents the time allowed for the receive direction. **NOTE** Link Symmetry is configured at the master ODU only. The appropriate matching Link Symmetry is set at the slave ODU automatically. For example, if Link Symmetry is configured as '2 to 1' at the master ODU, then the slave ODU will be set automatically as '1 to 2'. In this example, the master-slave direction has double the capacity of the slave-master direction.

Attribute	Meaning
Receive Modulation Mode Detail	This supplies the user with information regarding the receive modulation mode in use. Possible values are: 'Running at maximum receive mode' 'Running at user-configured Max Modulation Mode' 'Restricted due to byte errors on the wireless link or local Ethernet Tx Fifo Drops' 'Restricted because a DFS channel change is in progress' 'Restricted due to telecoms acquisition mode' 'Restricted due to the low Ethernet link speed' 'Limited by the wireless conditions'
Range	The range between the PTP 600 Series ODUs. This is displayed in km by default, but can be changed to miles by updating the 'Distance Units' attribute to imperial, as described in Protecting access to the summary and status pages on page 6-41.

TDD synchronization status

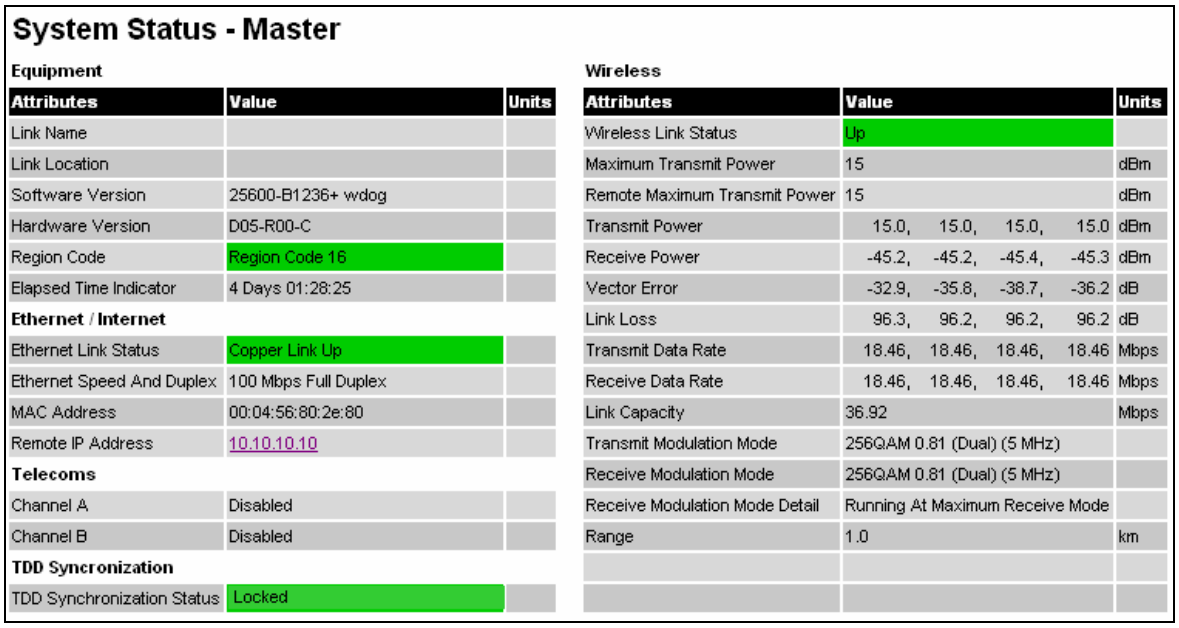
The Status Page displays the TDD Synchronization status for the link.

If TDD Synchronization is not enabled, the Attribute is set to 'TDD Synchronization Inactive' and the Value is set to 'Timing System Not Connected'.

If TDD Synchronization is enabled and the installation is rebooted, the Attribute is set to 'TDD Synchronization Status' and the Value is set to one of the following:

- 'Locked' (Figure 163)
- 'Holdover'
- 'Holdover (Not Connected)'
- 'Acquiring Lock'
- 'No Timing Reference'
- 'Timing System Not Connected' (Figure 164)
- 'Initializing'

Figure 163 Status page - TDD enabled and synchronized



System Status - Master

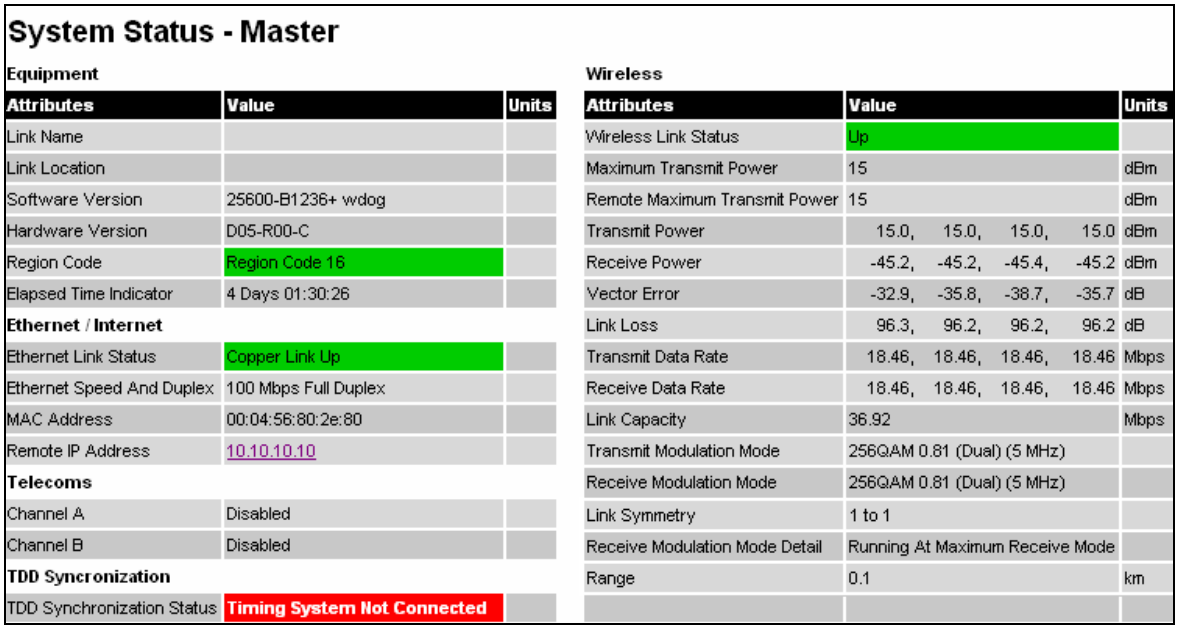
Equipment

Attributes	Value	Units
Link Name		
Link Location		
Software Version	25600-B1236+ wdog	
Hardware Version	D05-R00-C	
Region Code	Region Code 16	
Elapsed Time Indicator	4 Days 01:28:25	
Ethernet / Internet		
Ethernet Link Status	Copper Link Up	
Ethernet Speed And Duplex	100 Mbps Full Duplex	
MAC Address	00:04:56:80:2e:80	
Remote IP Address	10.10.10.10	
Telecoms		
Channel A	Disabled	
Channel B	Disabled	
TDD Syncronization		
TDD Synchronization Status	Locked	

Wireless

Attributes	Value	Units
Wireless Link Status	Up	
Maximum Transmit Power	15	dBm
Remote Maximum Transmit Power	15	dBm
Transmit Power	15.0, 15.0, 15.0, 15.0	dBm
Receive Power	-45.2, -45.2, -45.4, -45.3	dBm
Vector Error	-32.9, -35.8, -38.7, -36.2	dB
Link Loss	96.3, 96.2, 96.2, 96.2	dB
Transmit Data Rate	18.46, 18.46, 18.46, 18.46	Mbps
Receive Data Rate	18.46, 18.46, 18.46, 18.46	Mbps
Link Capacity	36.92	Mbps
Transmit Modulation Mode	256QAM 0.81 (Dual) (5 MHz)	
Receive Modulation Mode	256QAM 0.81 (Dual) (5 MHz)	
Receive Modulation Mode Detail	Running At Maximum Receive Mode	
Range	1.0	km

Figure 164 Status page - TDD enabled and not synchronized



System Status - Master

Equipment

Attributes	Value	Units
Link Name		
Link Location		
Software Version	25600-B1236+ wdog	
Hardware Version	D05-R00-C	
Region Code	Region Code 16	
Elapsed Time Indicator	4 Days 01:30:26	
Ethernet / Internet		
Ethernet Link Status	Copper Link Up	
Ethernet Speed And Duplex	100 Mbps Full Duplex	
MAC Address	00:04:56:80:2e:80	
Remote IP Address	10.10.10.10	
Telecoms		
Channel A	Disabled	
Channel B	Disabled	
TDD Syncronization		
TDD Synchronization Status	Timing System Not Connected	

Wireless

Attributes	Value	Units
Wireless Link Status	Up	
Maximum Transmit Power	15	dBm
Remote Maximum Transmit Power	15	dBm
Transmit Power	15.0, 15.0, 15.0, 15.0	dBm
Receive Power	-45.2, -45.2, -45.4, -45.2	dBm
Vector Error	-32.9, -35.8, -38.7, -35.7	dB
Link Loss	96.3, 96.2, 96.2, 96.2	dB
Transmit Data Rate	18.46, 18.46, 18.46, 18.46	Mbps
Receive Data Rate	18.46, 18.46, 18.46, 18.46	Mbps
Link Capacity	36.92	Mbps
Transmit Modulation Mode	256QAM 0.81 (Dual) (5 MHz)	
Receive Modulation Mode	256QAM 0.81 (Dual) (5 MHz)	
Link Symmetry	1 to 1	
Receive Modulation Mode Detail	Running At Maximum Receive Mode	
Range	0.1	km

Managing alarms and events

This section describes how to manage PTP 600 system alarms and events.

This section contains the following procedures:

- Managing alarms on page 7-14.
- Managing email alerts on page 7-18.
- Managing event notification messages on page 7-19.

Managing alarms

Whenever system alarms are outstanding, a yellow warning triangle is displayed on the navigation bar. The warning triangle is visible from all web pages. Click the warning triangle (or menu option **Home**) to return to the System Summary page and view the alarms. If the warning triangle disappears when it is clicked, it indicates that the outstanding alarms have been cleared.

The alarm configuration procedure is described in Task 8: Configuring alarms and messages on page 6-77.

The example in Figure 165 shows the warning triangle in the navigation bar and the 'Channel A' alarm displayed in the System Summary page. The alarms are defined in Table 133.

A change of state in most alarms generates an SNMP trap or an SMTP email alert.

Figure 165 Alarm warning triangle

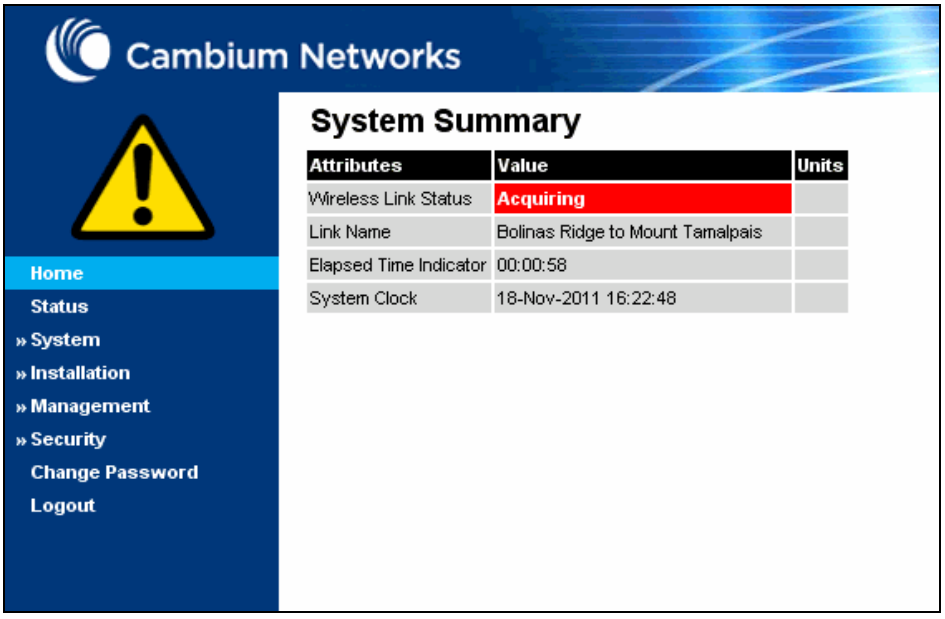


Table 133 System alarms

Alarm	Meaning
Channel A or Channel B	The current status of telecoms channels A or B. Alarm conditions are as follows: 'No Signal (Local)': There is no telecoms signal present at the connection to the ODU at the local end. 'No Signal (Remote)': There is an absence of telecoms data across the wireless link. 'No Signal (Local and Remote)': The above two alarm conditions occur concurrently. 'Remote Timing': There is insufficient wireless capacity available to carry telecoms data. Under these conditions telecoms timing information is still sent to keep the telecoms clocks synchronized. 'No Signal (Local) and Remote Timing': Indicates both no local signal and remote timing. In remote timing mode the ODU will transmit an Alarm Indication Signal (AIS), consisting of all-ones, from the associated telecoms interface.
Channel A Loopback or Channel B Loopback	The loopback status of telecoms channel A and B. These are intended for installation testing and should be set to 'None' for normal operation. The wire connections to a unit can be tested by applying a 'Copper' loopback to the local unit. The wireless connection to the remote unit can be tested by applying a 'Wireless' loopback to the remote unit with no loopback on the local unit. The loopback can be disabled from the telecoms configuration sub menu (see Performing a telecoms loopback test on page 8-16).
Data Port Configuration Mismatch	See 'Ethernet Configuration Mismatch'.
Data Port Disabled Warning	See 'Ethernet Link Disabled Warning'.
Data Port Fiber Status	See 'Fiber Link Status'.
Data Port Status	See 'Ethernet Link Status'.

Alarm	Meaning
Ethernet Bridging Status	'Diabled' means that the link has stopped bridging Ethernet frames because the Lowest Ethernet Modulation Mode is not being achieved or because the wireless link is down.
Ethernet Configuration Mismatch	Ethernet fragments (runt packets) have been detected when the link is in full duplex. This indicates an auto-negotiation or forced configuration mismatch.
Ethernet Link Disabled Warning	The Ethernet link has been administratively disabled via the SNMP Interface. The Ethernet Interface MIB-II ifAdminStatus attribute has been set to DOWN. To enable the Ethernet interface, set the ifAdminStatus attribute to UP.
Ethernet Link Status	A non-OK value indicates that the Ethernet link is down. The most likely cause is that the unit has no Ethernet cable plugged into its PIDU+ port.
Fiber Link Status	A non-OK value indicates that the fiber link is down. There are two possible causes: Either: the fiber link has been installed but disabled (because the license key does not include fiber support), Or: the fiber link could not be established even though a fiber carrier was detected (due perhaps to a broken TX fiber, or the link is disabled at the fiber link partner).
Fips Operational Mode Alarm	The unit is FIPS 140-2 capable, but has not been configured correctly for FIPS 140-2 operation. The FIPS operational mode alarm values are: 'FIPS mode is not configured': The Security Wizard has not been completed. 'FIPS mode is configured, but not active': The Security Wizard has been completed, but the HTTP and Telnet management interfaces have not been disabled.
Incompatible Master and Slave	A non-OK value indicates that the master and slave ends of the wireless link are different hardware products, or have different software versions. It is very unusual to detect this because incompatible units will normally fail to establish a wireless link. However, some combinations may establish a partial wireless link and detect this situation.
Incompatible Region Codes	The two linked units have different region codes. To clear this alarm, obtain and install license keys for the same region code, see Task 3: Installing license keys on page 6-14.

Alarm	Meaning
Install Arm State	A wireless unit is in installation mode. After installation, the wireless unit should be disarmed. This will increase the data-carrying capacity and stop the installation tone generator. The wireless link is disarmed from the 'Installation' process, see Disarming the units on page 6-91.
Install Status	A non-OK value indicates that signaling was received with the wrong MAC address. It is very unusual to detect this, because units with wrongly configured Target MAC Address will normally fail to establish a wireless link. However, rare circumstances may establish a partial wireless link and detect this situation.
Link Mode Optimization Mismatch	The Master and Slave ODUs are configured to use different link mode optimization methods (one is set to IP and the other TDM).
Management Port Configuration Mismatch	Ethernet fragments (runt packets) have been detected when the out-of-band management link is in full duplex. This indicates an auto-negotiation or forced configuration mismatch.
Management Port Disabled Warning	The out-of-band management link has been administratively disabled via the SNMP Interface.
Management Port Status	A non-OK value indicates that the out-of-band management link is down. The most likely cause is that the unit has no Ethernet cable plugged into its AUX port.
No Wireless Channel Available	Spectrum Management was unable to locate a suitable wireless channel to operate on.
Region Code	The installed license key contains an invalid region code. The wireless unit is prohibited from operating outside the regulated limits.
SNTP Synchronization failed	SNTP has been enabled but the unit is unable to synchronize with the specified SNTP server. Setting the real-time clock on page 6-100 explains how to configure SNTP.
Syslog Local Enable Disable	The local log of event messages has been enabled or disabled. See Task 9: Configuring syslog on page 6-81.
Syslog Local Nearly Full	The local log of event messages is nearly full.
Syslog Local Wrapped	The local log of event messages is full and is now being overwritten by new messages.
TDD Synchronization Alarm	The current status of the TDD Synchronization (OK, Timing System Failure, Not Synchronized).

Alarm	Meaning
Unit Out Of Calibration	The unit is out of calibration and must be returned to the factory using the RMA process for re-calibration.
Wireless Link Disabled Warning	The wireless link has been administratively disabled via the SNMP Interface. The wireless interface MIB-II ifAdminStatus attribute has been set to DOWN. To enable the Ethernet interface, set the ifAdminStatus attribute to UP.

Managing email alerts

The management agent can be configured to generate alerts by electronic mail when certain events occur. The email message configuration procedure is described in Task 8: Configuring alarms and messages on page 6-77. The alerts are defined in Table 134.

Table 134 Email alerts

Alert	Meaning
Wireless Link Up Down	There has been a change in the status of the wireless link.
DFS Channel Change	DFS has forced a change of channel.
DFS Impulse Interference	DFS has detected impulse interference.
Enabled Diagnostic Alarms	Diagnostic alarms have been enabled.
Ethernet Link Up Down (or Data Port Up Down)	There has been a change in the status of the Ethernet link or data port.
Management Port Up Down	There has been a change in the status of the management port.
Telecoms Channel Up Down	There has been a change in the status of the telecoms (E1 or T1) channel.

Managing event notification messages

When system logging is enabled, log entries are added to the internal log and (optionally) transmitted as UDP messages to one or two syslog servers.

For more information about system logging, refer to:

- System logging (syslog) on page 1-55 describes the system logging feature.
- Syslog message formats on page 4-48 describes the format and content of Syslog event messages.
- Task 9: Configuring syslog on page 6-81 describes the system logging configuration procedure.

To enable system logging, select menu option **Management, Syslog, Syslog configuration**. The Syslog Configuration page is displayed (Figure 143). Set the Syslog State attribute to 'Enabled'.

To view the log, select menu option **Management, Syslog**. The local log is displayed (Figure 166).

Figure 166 Syslog local log

Entry	Relative Time	Timestamp	Facility	Priority	Text
989	00:00:05	Sep 02 13:27:21	Security	Info	event; auth_login; Web user=Geri; from=10.130.1.73; port=443; connection=HTTPS; authentication=local;
988	00:00:17	Sep 02 13:27:09	Security	Info	event; auth_login; Web user=MelC; from=10.130.1.175; port=443; connection=HTTPS; authentication=local;
987	00:00:56	Sep 02 13:26:28	Security	Info	event; auth_logout; Web user=Geri; from=10.130.1.175; port=443; connection=HTTPS; authentication=local;
986	00:01:05	Sep 02 13:26:19	Security	Info	event; auth_login; Web user=Geri; from=10.130.1.175; port=443; connection=HTTPS; authentication=local;
985	00:01:51	Sep 02 13:25:35	NTP	Warning	status; SNTP Sync; was=No Sync; now=In Sync;

Managing spectrum

This section describes how to configure the spectrum management feature of the PTP 600 and how to interpret spectrum management graphical plots.

This section contains the following procedures:

- Configuring spectrum usage at the master on page 7-20
- Viewing spectrum usage at the slave on page 7-23
- Interpreting the spectrum management plots on page 7-24
- Viewing the active channel history on page 7-32
- Viewing historic spectrum management metrics on page 7-33

Configuring spectrum usage at the master

All spectrum management configuration changes are applied at the master ODU only. These changes are then sent from the master to the slave, so that both master and slave keep identical copies of spectrum management configuration. It is therefore possible to swap master and slave roles on an active PTP 600 link without modifying Spectrum Management configuration.

> **NOTE**
> Before attempting to improve the performance of the spectrum management algorithm by changing the default configuration, consulting the Cambium Point-to-Point distributor or one of the system field support engineers.

The default channelization can be modified by varying the lower center frequency attribute in the installation wizard, as described in Step 2: Wireless configuration on page 6-51.

To configure spectrum usage at the master, log into the master ODU for the link. Select menu option **System, Spectrum Management**. The Spectrum Management page is displayed (Figure 167). Review and update the configuration attributes (Table 135) and select **Submit configuration changes**.

Figure 167 illustrates 15 MHz operation; other channel bandwidths are similar. The width of the vertical green bar represents the channel width.

Figure 167 Spectrum Management as seen from the Master

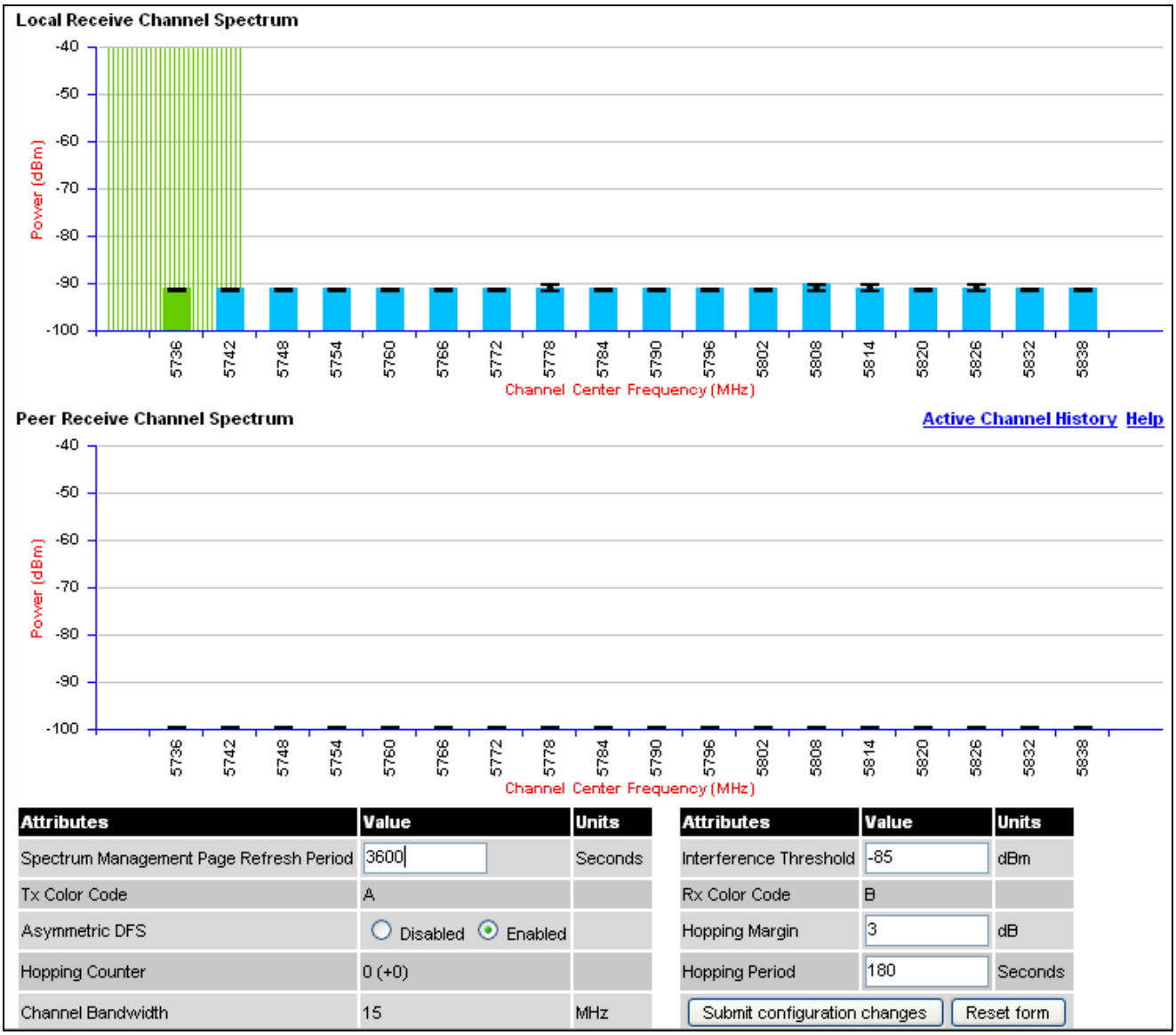


Table 135 Spectrum Management attributes

Attribute	Meaning
Page Refresh Period	The page refreshes automatically according to the setting entered here (in seconds).
Hopping Margin	Spectrum Management uses this margin when making a channel hop decision. If the interference level of the target channel is lower than that of the active channel by at least the Hopping Margin, the link will hop to the target channel. The default setting is 3 dB in non-radar regions, or 10 dB in radar regions.

Attribute	Meaning
Asymmetric DFS	Only displayed in non-radar regions when i-DFS is enabled. The default configuration of symmetric operation constrains the link to operate symmetrically, using the same transmit and receive channels. When in symmetric mode the slave unit will always follow the master. If the master moves to a new channel the slave will hop to the same channel. When the Point-to-Point link is configured as an asymmetric link both the master and slave are free to select the best channel from their own set of local interference metrics.
Spectrum Management Control	Only displayed in radar regions. The options are 'DFS' and 'DFS with i-DFS'.
Hopping Period (not configurable)	The Spectrum Management algorithm evaluates the metrics every 'Hopping Period' seconds (180 seconds by default) looking for a channel with lower levels of interference. If a better channel is located, Spectrum Management performs an automated channel hop. If SNMP or SMTP alerts are enabled an SNMP TRAP or an email alert is sent warning the system administrator of the channel change.
Hopping Counter	This is used to record the number of channel hops. The number in the (+) brackets indicates the number of channel changes since the last screen refresh.
Interference Threshold	Spectrum Management uses the interference threshold to perform instantaneous channel hops. If the measured interference on a channel exceeds the specified threshold, then i-DFS will instruct the wireless to immediately move to a better channel. If a better channel cannot be found the PTP 600 Series will continue to use the current active channel. (Default –85 dBm).
Channel Bandwidth (not configurable)	This shows the value of the variable channel bandwidth selected.

Barring a channel

Channels can only be barred or unbarred from the master Spectrum Management web page. Refer to Barring channels on page 6-62.

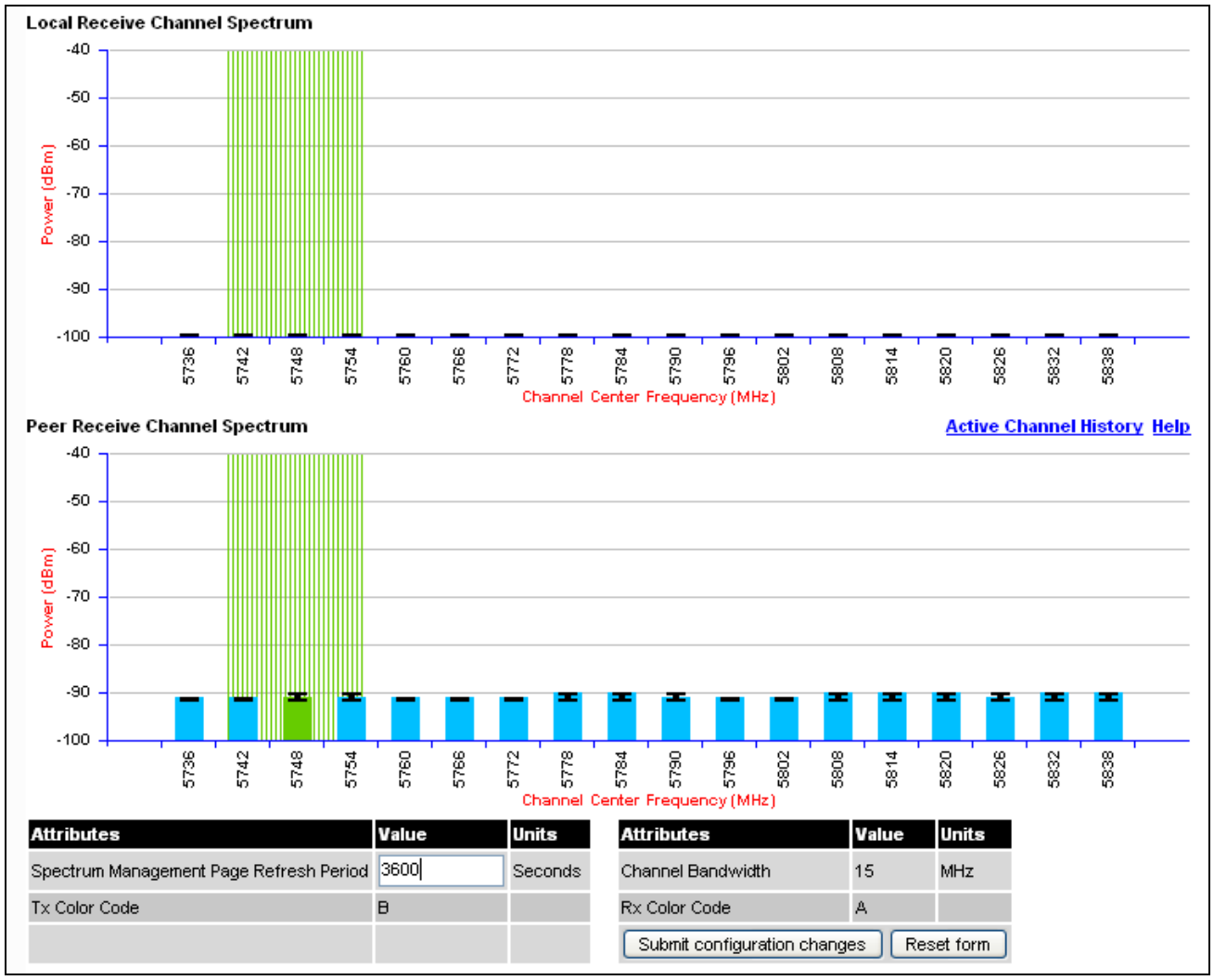
The channel bar will take effect immediately and is not related to the measurement quantization period.

Viewing spectrum usage at the slave

To view spectrum usage at the slave, log into the slave ODU for the link. Select menu option **System, Spectrum Management**. The Spectrum Management page is displayed (Figure 168). If necessary, update the Page Refresh Period and select **Submit configuration changes**.

Figure 168 illustrates 15 MHz operation; other channel bandwidths are similar. The width of the vertical green bar represents the channel width.

Figure 168 Spectrum Management as seen from the Slave



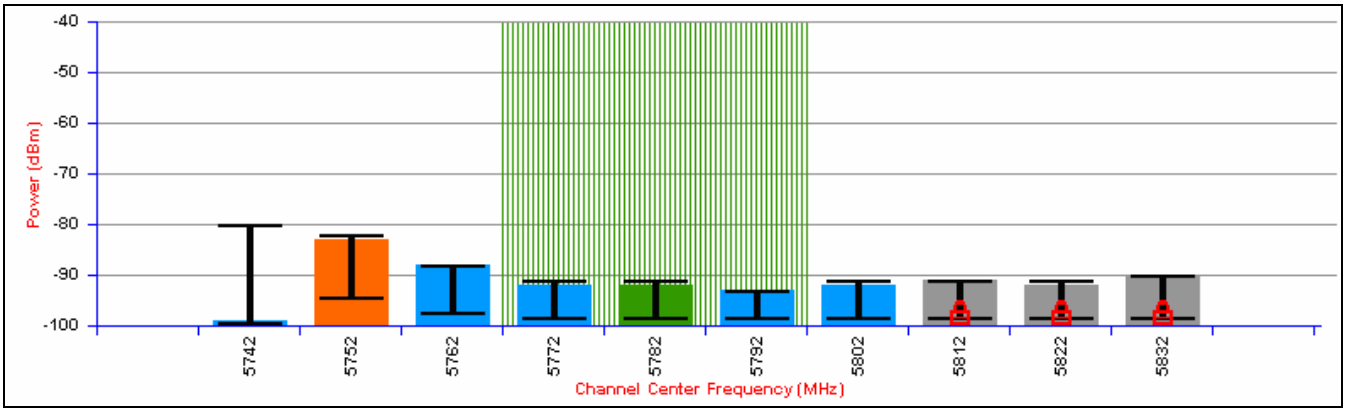
Interpreting the spectrum management plots

The Spectrum Management pages at the master and slave (Figure 167 and Figure 168) display two graphical plots:

- Local Receive Channel Spectrum
- Peer Receive Channel Spectrum

A more detailed example of one of these plots is shown in Figure 169.

Figure 169 Example spectrum management plot



NOTE

For more information, select the **Help** hyperlink from the Spectrum Management page.

X axis and Y axis

The X-axis shows a stylized view of the selectable wireless channels. Adjacent channels on the display have a 10 MHz overlap. Channels are displayed separately for clarity. The axis is labeled using the channel center frequencies in MHz.

The Y-axis shows the interference power levels from –100 to –40 dBm.

Channel states

The active channel (channel 5 in Figure 169) is always marked using hatched green and white lines. The width of the hatching is directly proportional the channel bandwidth spectral occupancy of the channel.

The individual channel metrics are displayed using a colored bar and an 'I' bar. The colored bar represents the channel state (Table 136).

Table 136 Channel states represented in the spectrum management plot

State	Meaning
Active	The channel is currently in use, hosting the Point-to-Point wireless link.
Interference	The channel has interference above the interference threshold.
Available	The channel has an interference level below the interference threshold and is considered by the Spectrum Management algorithm suitable for hosting the Point-to-Point link.
Barred	The system administrator has barred this channel from use. For improved visibility, an additional red 'lock' symbol is used to indicate that a channel is barred.

Key metrics

The 'I' bar and top of the colored bar represent three key metrics (Table 137). The vertical part of the 'I' bar represents the statistical spread between the peak and the mean of the statistical distribution.

Table 137 Key metrics represented in the spectrum management plot

Metric	Description	How represented
Peak of Means	The largest mean interference measurement encountered during the quantization period. The peak of means is useful for detecting slightly longer duration spikes in the interference environment.	Upper horizontal bar.
Mean of Means	The arithmetic mean of the measured means during a quantization period. The mean of means is a coarse measure of signal interference and gives an indication of the average interference level measured during the quantization period. The metric is not very good at predicting intermittent interference and is included to show the spread between the Mean of Means, the 99.9% Percentile and the Peak of Means.	Lower horizontal bar.
99.9% Percentile of the Means	The value of mean interference measurement which 99.9% of all mean measurements fall below, during the quantization period. The 99.9% percentile metric is useful for detecting short duration repetitive interference that by its very nature has a minimal effect of the mean of means.	Top of the colored bar.

NOTE

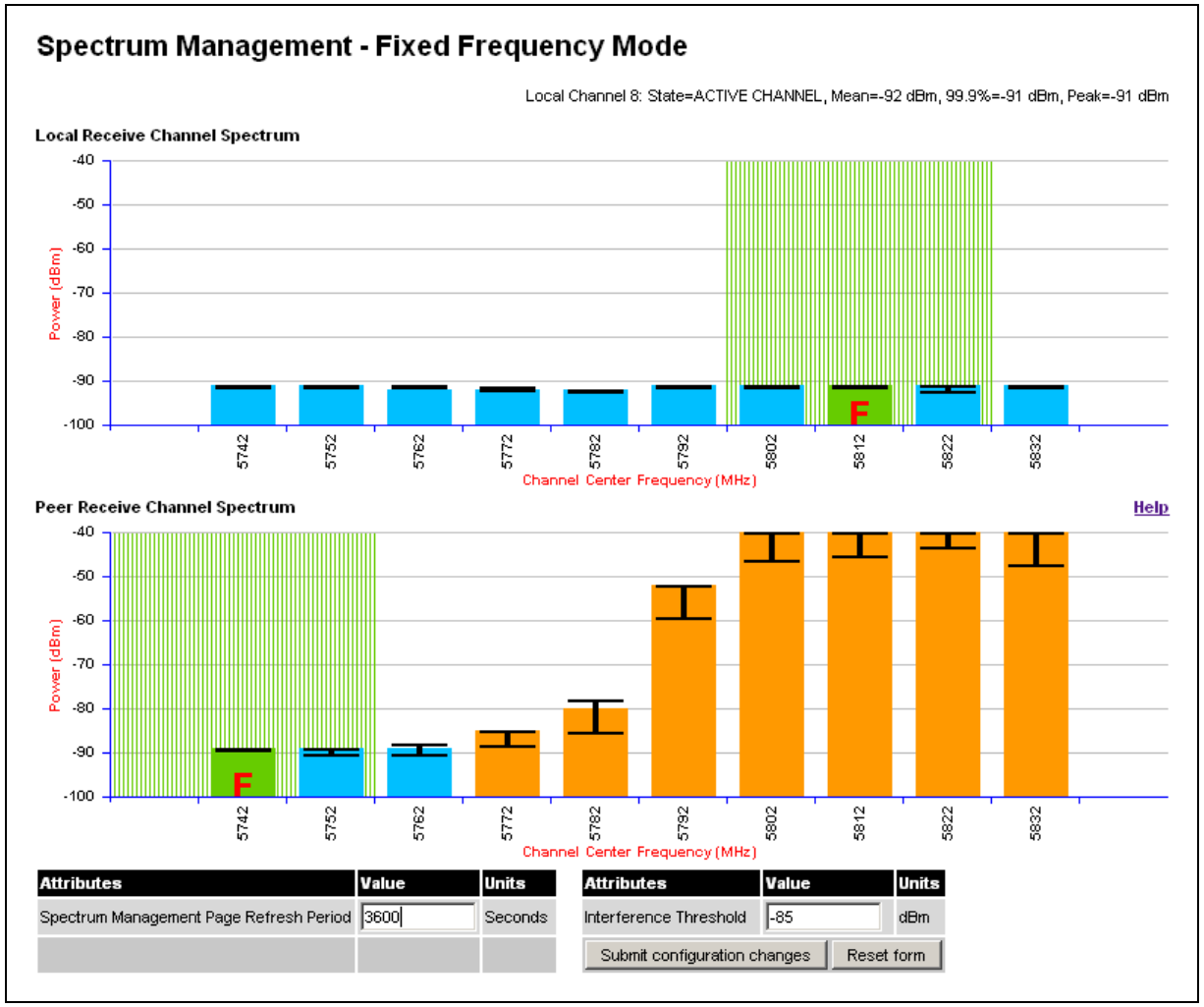
The arithmetic mean is the true power mean and not the mean of the values expressed in dBm.

Spectrum Management uses the 99.9% Percentile as the prime interference measurement. All subsequent references to interference level refer to this percentile measurement.

Spectrum management in fixed frequency mode

When the link is operating in fixed frequency mode, the Spectrum Management page uses two visual cues (Figure 170). The main page title has the 'Fixed Frequency Mode' suffix and the selected channels are identified by a red capital 'F'.

Figure 170 Spectrum Management Fixed Frequency Mode page



Channel barring is disabled in fixed frequency mode; it is not required as dynamic channel hopping is prohibited in this mode.

The only controls available to the master are the Page Refresh Period and Interference Threshold attributes. They will have no effect on the operation of the wireless link and will only effect the generation of the channel spectrum graphics.

The active channel history menu is removed in this mode of operation, as channel hopping is prohibited.

Spectrum management in radar avoidance mode

When the link is operating in radar avoidance mode, the Spectrum Management page (Figure 171 and Figure 172) contains the following additional information:

- The main page title has the 'Radar Avoidance' suffix.
- The only controls available to the master are the Interference Threshold attribute. This has no effect on the operation of the wireless link and will only affect the generation of the channel spectrum graphics.
- Extra color coding of the interference histogram is provided (Table 138).

When operating with RTTT (Road transport and Traffic Telematics) Avoidance enabled or other regulatory restrictions on channel usage, the page contains the following additional information:

- All channels marked with a 'no entry' symbol with their associated statistics colored black are the prohibited channels. These channels are never used to host the wireless link, but CAC measurements are still taken so that adjacent channel biases can be calculated correctly and so the user can see if other equipment is in use.

Figure 171 Spectrum Management page with radar avoidance - master

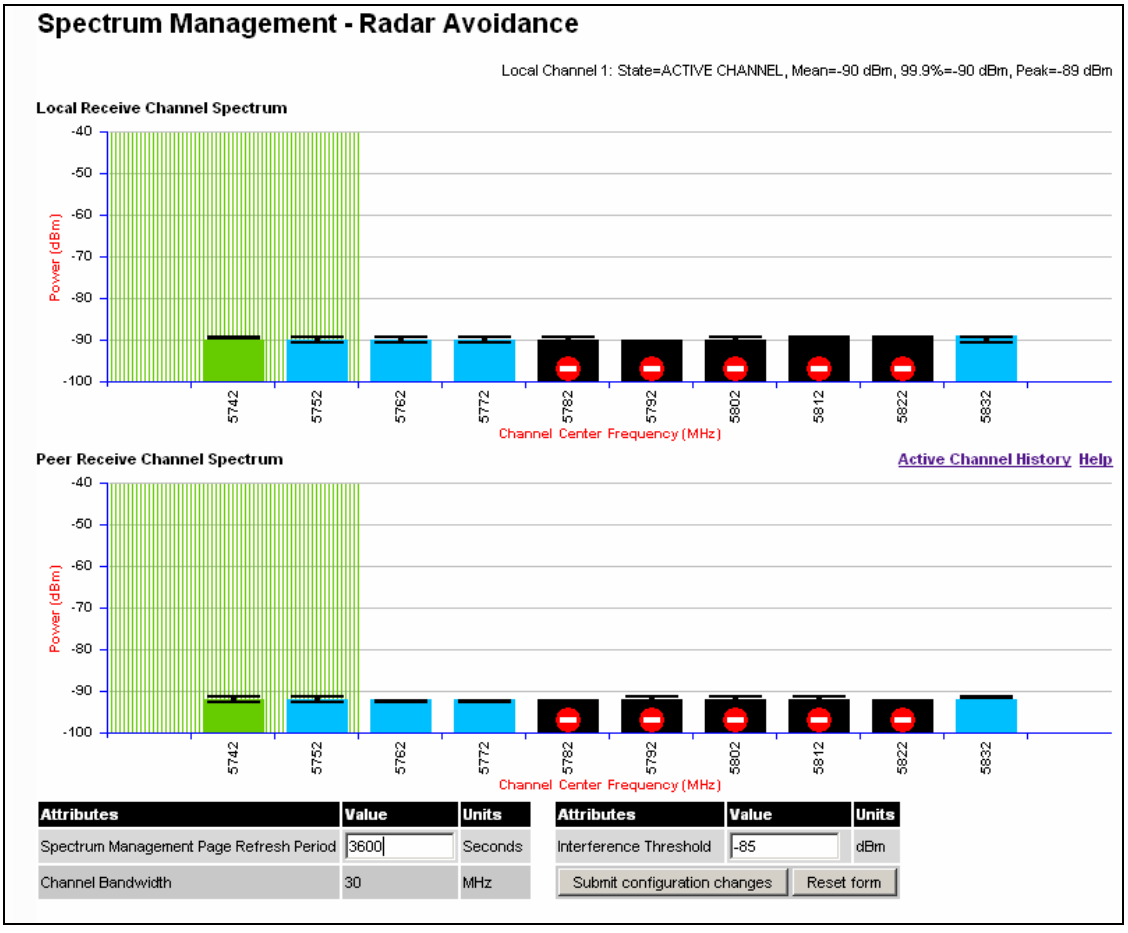


Figure 172 Spectrum Management page with radar avoidance - slave

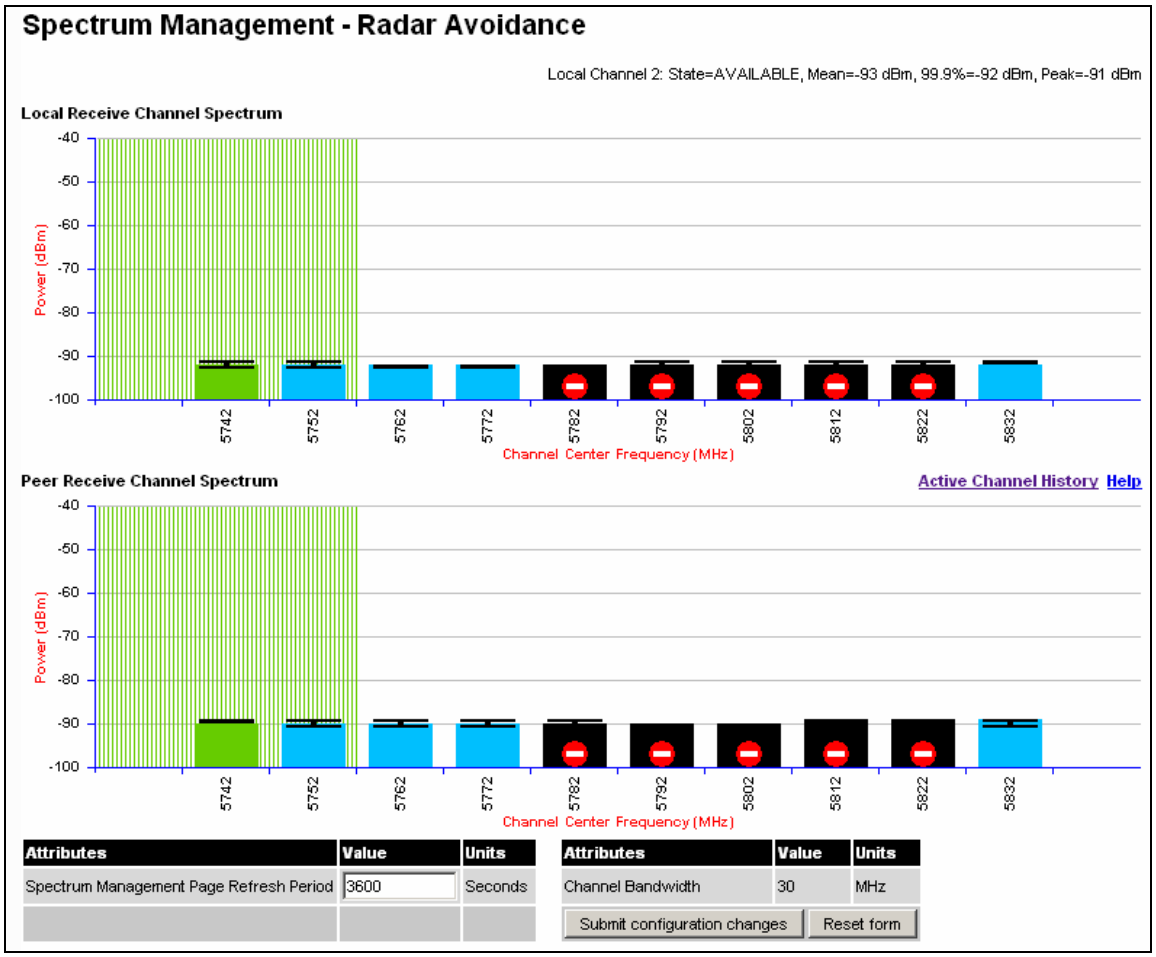


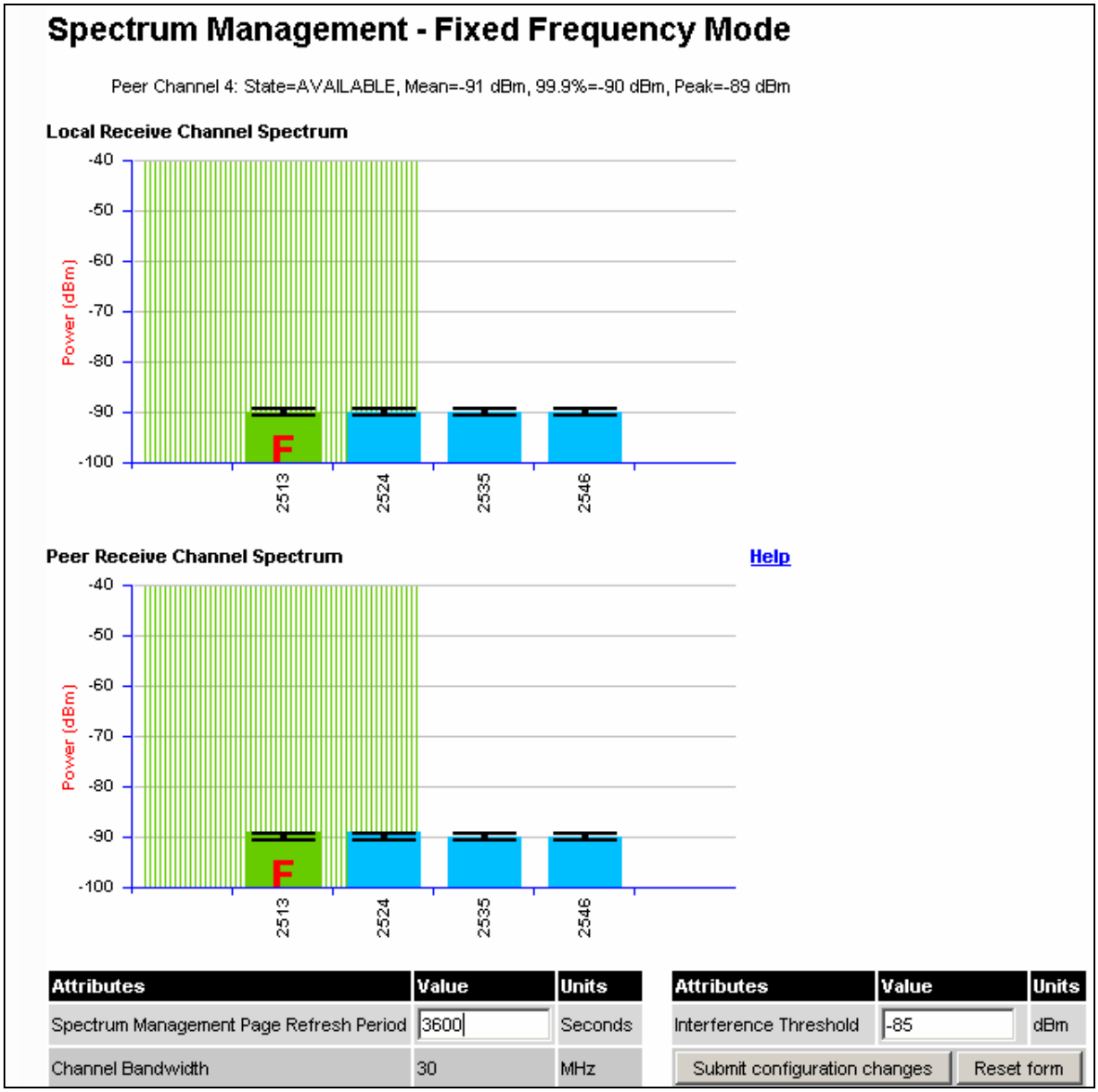
Table 138 Channel states in the spectrum management plot (radar avoidance)

State and color	Meaning
Active	This channel is currently in use hosting the Point-to-Point wireless link.
Interference	This channel has interference above the interference threshold
Available	This channel has an interference level below the interference threshold and is considered by the Spectrum Management algorithm suitable for hosting the Point-to-Point link
Barred	The system administrator has barred this channel from use. Because the low signal levels encountered when a unit is powered up in a laboratory environment prior to installation (which makes the grey of the channel bar difficult to see). An additional red 'lock' symbol is used to indicate that a channel is barred.
Unavailable	This channel needs to be monitored for one minute and found free of radar signal before it can be used for transmitting.
Radar Detected	Impulsive Radar Interference has been detected on this channel and the channel is unavailable for 30 minutes. At the end of the 30 minute period a Channel Availability Check is required to demonstrate no radar signals remain on this channel before it can be used for the radio link.
	This channel has been barred from use by the local region regulator

Spectrum management for the PTP 25600

The PTP 25600 frequency variant can operate in three frequency bands. Figure 173 shows an example of a Lower Band with a 30 MHz channel bandwidth.

Figure 173 PTP 25600 example of Spectrum Management page



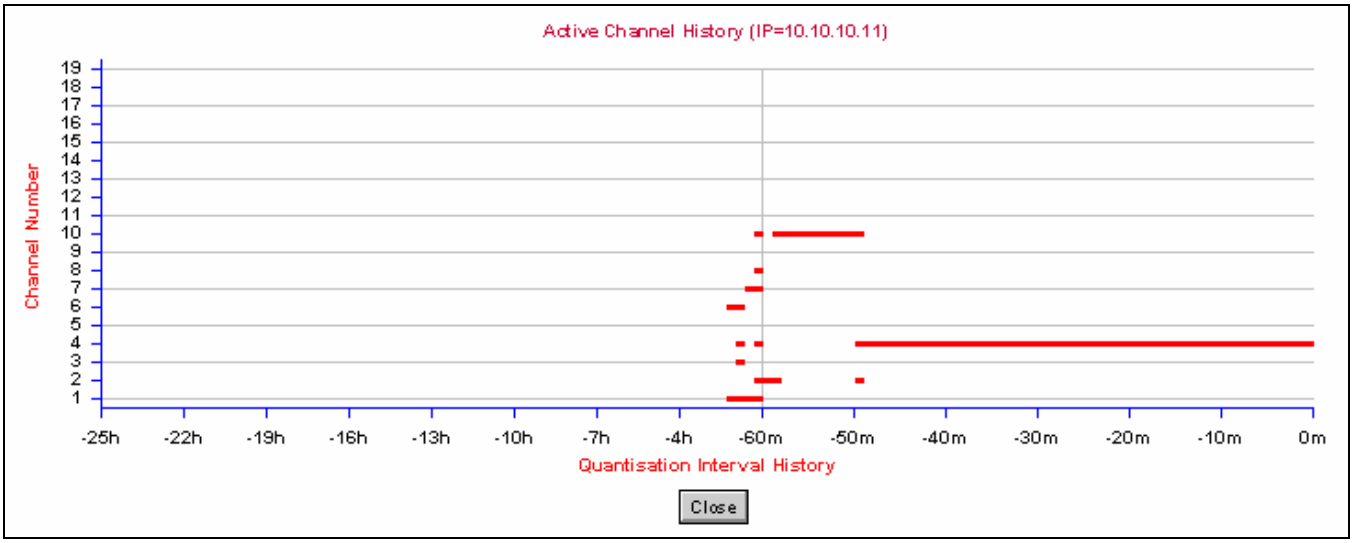
Viewing the active channel history

The active channel history is a time series display of the channels used by the PTP 600 Series over the last 25 hours.

To view the active channel history, select the **Active Channel History** hyperlink from the Spectrum Management page.

An example of the active channel history display is shown in Figure 174. Where there are parallel entries on the display this signifies that the wireless link occupied this channel during the measurement period. The measurement periods are one minute (from zero to sixty minutes) and twenty minutes from (60 minutes to twenty five hours).

Figure 174 Active channel history screen



Viewing historic spectrum management metrics

The results of previous measurement quantization periods can be viewed from both the master and slave Spectrum Management pages.

To view these results, hold down the shift key and click the appropriate channel on the Local Receive Channel Separation plot.

The time series plot is displayed (Figure 175). This plot displays the results of all previous measurement quantization periods, up to a maximum of 132 periods. The colored lines represent interference measurements (Table 139).

Figure 175 Spectrum management time series plot

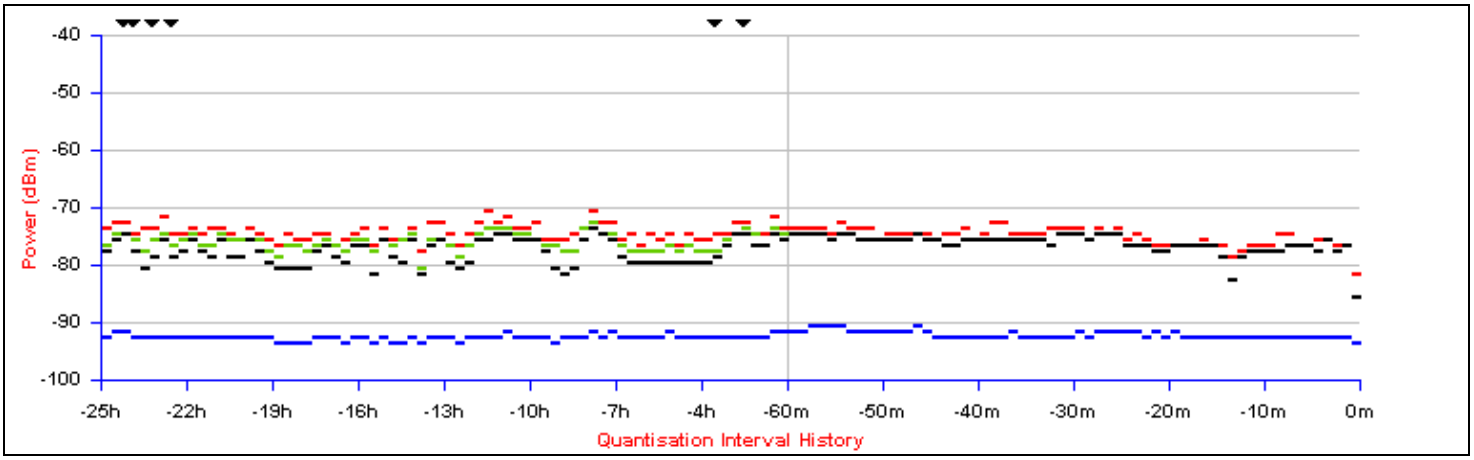


Table 139 Interference represented in the time series plot

Color	Meaning
GREEN	Peak of Means interference measurement
	99.9% percentile of means interference measurement
BLUE	Mean of Means interference measurement

Managing security

This section contains the following procedures:

- Exiting FIPS 140-2 or UC APL mode on page 7-34
- Zeroizing critical security parameters on page 7-34

Other security configuration procedures are described in Task 5: Configuring security on page 6-21.

Exiting FIPS 140-2 or UC APL mode

To exit from the FIPS 140-2 or UC APL mode, load PTP 600 software that is not FIPS 140-2 or UC APL validated.

> **NOTE**
> The critical security parameters (CSPs) are zeroized when the unit is no longer FIPS 140-2 Capable.

Zeroizing critical security parameters

Critical security parameters (CSPs) are as follows:

- Key of keys.
- AES encryption keys for the wireless interface.
- Private key for the HTTPS/TLS interface.
- Entropy value for the HTTPS/TLS interface.
- User account passwords for the web-based interface.

To zeroize the CSPs, select option **Security, Zeroize CSPs** and then **Select Zeroize CSPs and Reboot Wireless Unit**. Confirm the reboot.

Alternatively, select the **Zeroize CSPs** option in Recovery mode.

Managing performance

This section describes how to manage the performance of the PTP 600 link.

This section contains the following procedures:

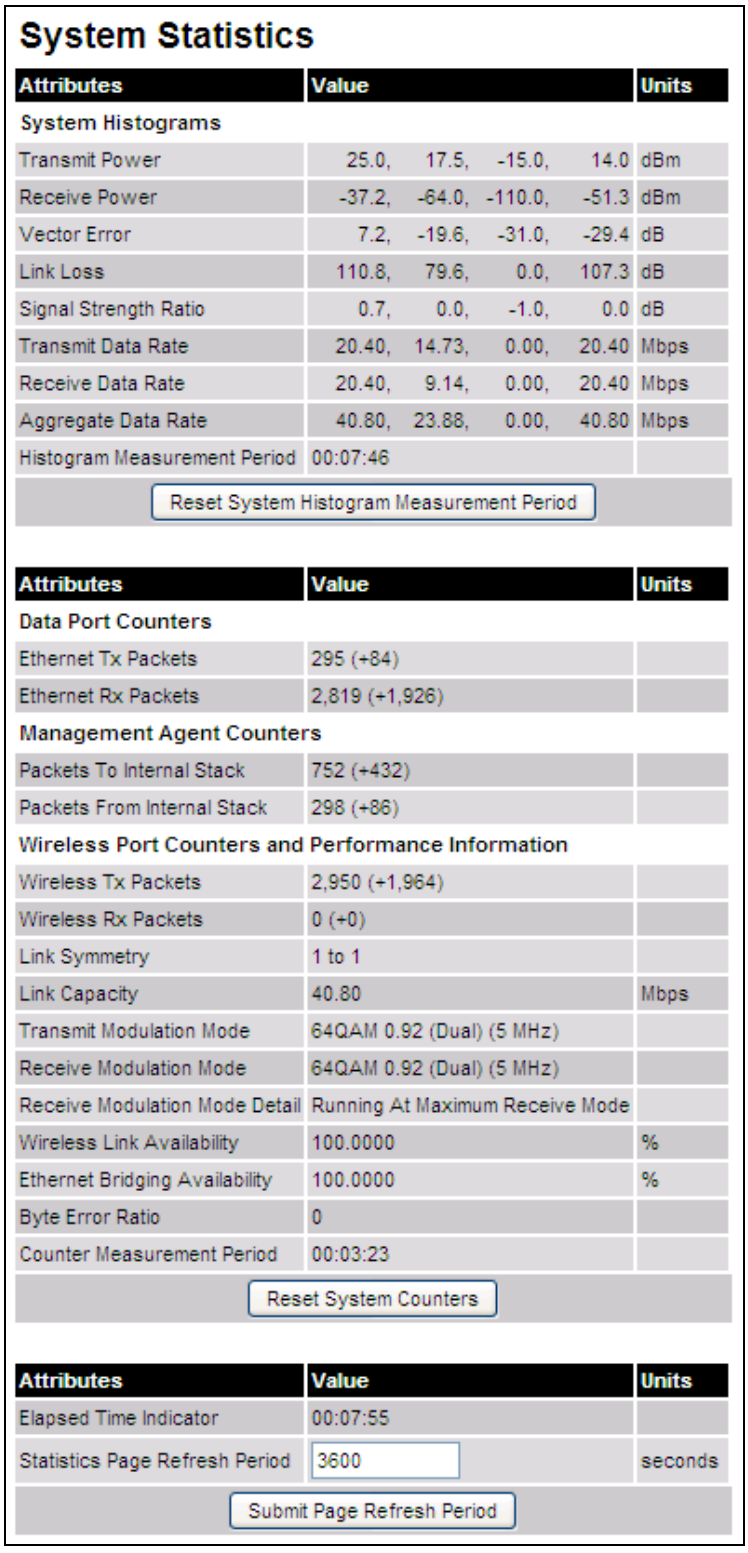
- Checking system statistics on page 7-35
- Checking detailed counters on page 7-41
- Using the diagnostics plotter on page 7-45
- Downloading diagnostic data on page 7-46
- Diagnostics calculated over time on page 7-47

Checking system statistics

To check system statistics, select menu option **System, Statistics**. The System Statistic page is displayed (Figure 176).

> **NOTE**
> To enable or disable the display of commas in long integers (for example 1,234,567), select menu option **Management, Web, Web Properties** and update the Use Long Integer Comma Formatting attribute.

Figure 176 System Statistics page



System Statistics

Attributes	Value	Units
System Histograms		
Transmit Power	25.0, 17.5, -15.0, 14.0	dBm
Receive Power	-37.2, -64.0, -110.0, -51.3	dBm
Vector Error	7.2, -19.6, -31.0, -29.4	dB
Link Loss	110.8, 79.6, 0.0, 107.3	dB
Signal Strength Ratio	0.7, 0.0, -1.0, 0.0	dB
Transmit Data Rate	20.40, 14.73, 0.00, 20.40	Mbps
Receive Data Rate	20.40, 9.14, 0.00, 20.40	Mbps
Aggregate Data Rate	40.80, 23.88, 0.00, 40.80	Mbps
Histogram Measurement Period	00:07:46	

Reset System Histogram Measurement Period

Attributes	Value	Units
Data Port Counters		
Ethernet Tx Packets	295 (+84)	
Ethernet Rx Packets	2,819 (+1,926)	
Management Agent Counters		
Packets To Internal Stack	752 (+432)	
Packets From Internal Stack	298 (+86)	
Wireless Port Counters and Performance Information		
Wireless Tx Packets	2,950 (+1,964)	
Wireless Rx Packets	0 (+0)	
Link Symmetry	1 to 1	
Link Capacity	40.80	Mbps
Transmit Modulation Mode	64QAM 0.92 (Dual) (5 MHz)	
Receive Modulation Mode	64QAM 0.92 (Dual) (5 MHz)	
Receive Modulation Mode Detail	Running At Maximum Receive Mode	
Wireless Link Availability	100.0000	%
Ethernet Bridging Availability	100.0000	%
Byte Error Ratio	0	
Counter Measurement Period	00:03:23	

Reset System Counters

Attributes	Value	Units
Elapsed Time Indicator	00:07:55	
Statistics Page Refresh Period	3600	seconds

Submit Page Refresh Period

System histograms

The System Histograms attributes (Table 140) are presented as an array of four elements. These elements represent the maximum, mean, minimum and latest values respectively. The maximum, mean and minimum are calculated over a running one hour period.

To reset all histograms and restart the measurement period, select **Reset System Histograms and Measurement Period**.

Table 140 System Histograms attributes in the System Statistics page

Attribute	Meaning
Transmit Power	The transmit power histogram, calculated over a one hour period.
Receive Power	The receive power histogram, calculated over a one hour period.
Vector Error	The vector error measurement compares the received signal IQ modulation characteristics to an ideal signal to determine the composite vector error magnitude. The histogram is calculated over a one hour period.
Link Loss	The link loss measurement is calculated as follows: Peer_Tx_Power (dBm) – Local_Rx_Power (dBm) + 2 x Antenna_Pattern (dBi) The histogram is calculated over a one hour period.
Signal Strength Ratio	The Signal Strength Ratio is: Power received by the vertical antenna input (dB) ÷ Power received by the horizontal antenna input (dB) This ratio is presented as: max, mean, min, and latest in an histogram format. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means. See Diagnostics calculated over time on page 7-47.
Transmit Data Rate	The data rate in the transmit direction, expressed in Mbps and presented as: max, mean, min, and latest in an histogram format. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means. Expected data rates can be found in Data throughput tables on page 4-74.
Receive Data Rate	The data rate in the receive direction, expressed in Mbps and presented as: max, mean, min, and latest in an histogram format. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means. Expected data rates can be found in Data throughput tables on page 4-74

Attribute	Meaning
Aggregate Data Rate	The sum of the data rate in the directions expressed in Mbps and presented as: max, mean, min, and latest in an histogram format. The max, min and latest are true instantaneous measurements; the mean is the mean of a set of one second means. Expected data rates can be found in Data throughput tables on page 4-74.
Histogram Measurement Period	The time over which the system histograms were collected.

Signal Strength Ratio is an aid to debugging a link. If it has a large positive or negative value then investigate the following potential problems:

- An antenna coaxial lead may be disconnected.
- When spatial diversity is employed, the antenna with the lower value may be pointing in the wrong direction.
- When a dual polar antenna is deployed, the antenna may be directed using a side lobe rather than the main lobe.

When there is a reflection from water on the link and spatial diversity is employed, then one expects large, slow swings in Signal Strength Ratio. This indicates the antenna system is doing exactly as intended.

System counters

The System Statistics page contains the following system counters:

- Data port counters (Table 141)
- Management port counters (Table 142)
- Wireless port counters and performance information (Table 143)

The packet counter attributes each contain a number in parentheses; this shows the number of packets received since the last page refresh.

To reset all system counters to zero, select **Reset System Counters**.

Table 141 Data Port Counter attributes in the System Statistics page

Attribute	Meaning
Ethernet Tx Packets	This displays the total number of good packets the bridge has sent for transmission by the local Ethernet interface.

Table 142 Management Port Counter attributes in the System Statistics page

Attribute	Meaning
Packets To Internal Stack	This displays the total number of good packets the bridge has transmitted to the internal stack (for example, ARP requests, PING requests, HTTP requests).
Packets From Internal Stack	This displays the total number of good packets the bridge has received from the internal stack (for example ARP responses, PING replies, HTTP responses).

Table 143 Wireless Port Counter attributes in the System Statistics page

Attribute	Meaning
Wireless Tx Packets	This displays the total number of good packets the bridge has sent for transmission by the wireless interface.
Wireless Rx Packets	This displays the total number of good packets the bridge has received from the wireless interface.
Link Symmetry	A ratio that expresses the division between transmit and receive time in the TDD frame. The first number in the ratio represents the time allowed for the transmit direction and the second number represents the time allowed for the receive direction.
Link Capacity	The maximum aggregate data capacity available for user traffic under the current radio link conditions, assuming the units have been connected using Gigabit Ethernet. The sum of the displayed Transmit and Receive data rates may be lower than this figure if the link isn't fully loaded by the current traffic profile.
Transmit Modulation Mode	The modulation mode currently being used on the transmit channel. The number in brackets after the modulation mode and coding rate string is the effective data rate available to all MAC layer protocols. List of all the modulation modes can be found in Data throughput tables on page 4-74, where data rate calculations plots are given for each available modulation mode.
Receive Modulation Mode	The modulation mode currently being used on the receive channel. The number in brackets after the modulation mode and coding rate string is the effective data rate available to all MAC layer protocols. List of all the modulation modes can be found in Data throughput tables on page 4-74, where data rate calculations plots are given for each available modulation mode.

Attribute	Meaning
Receive Modulation Mode Detail	This supplies the user with information regarding the receive modulation mode in use. Possible values are: 'Running at maximum receive mode' 'Running at user-configured Target Modulation Mode' 'Restricted because Installation is armed' 'Restricted because of byte errors on the wireless link' 'Restricted because a DFS channel change is in progress' 'Restricted due to the low Ethernet link speed' 'Limited by the radio conditions'
Wireless Link Availability	Wireless link availability calculated since the last reset of the system counters.
Ethernet Bridging Availability	Link availability for bridging Ethernet traffic calculated since the last reset of the system counters. This is the percentage of time in which the Ethernet Bridging Status attribute has been in the 'Enabled' state.
Byte Error Ratio	The ratio of detected Byte errors to the total number of bytes since the last system reboot. This is a true measure of link quality as this measurement is made continually using null frames when there is no user data to transport.
Counter Measurement Period	The time over which the system counters were collected.

Other attributes

The System Statistics page contains two other attributes (Table 144).

After updating the Statistics Page Refresh Period field, select **Submit Page Refresh Period**.

Table 144 Other attributes in the System Statistics page

Attribute	Meaning
Elapsed Time Indicator	Elapsed time since the last system reboot.
Statistics Page Refresh Period	The statistics page refreshes automatically according to the setting entered here (in seconds).

Checking detailed counters

The Detailed Counters page displays detailed statistics of the Ethernet Bridge and the underlying wireless performance.

The Detailed Counters page is subdivided into two columns: Ethernet interface and wireless interface.

To check detailed counters, select menu option **System, Statistics, Detailed Counters**. The Detailed Counters page is displayed (Figure 177). Review the detailed counters (Table 145).

Figure 177 Detailed Counters page

Detailed Counters

Ethernet

Attributes	Value	Units
Ethernet Rx Octets	0 (+0)	
Ethernet Tx Octets	0 (+0)	
Ethernet Rx Drops	0 (+0)	
Ethernet Rx Packets	0 (+0)	
Ethernet Rx Broadcasts	0 (+0)	
Ethernet Rx Multicasts	0 (+0)	
Ethernet Rx Crc And Align	0 (+0)	
Ethernet Rx Undersize	0 (+0)	
Ethernet Rx Oversize	0 (+0)	
Ethernet Rx Fragments	0 (+0)	
Ethernet Rx Jabbers	0 (+0)	
Ethernet Rx 64 Bytes	0 (+0)	
Ethernet Rx 65 To 127 Bytes	0 (+0)	
Ethernet Rx 128 To 255 Bytes	0 (+0)	
Ethernet Rx 256 To 511 Bytes	0 (+0)	
Ethernet Rx 512 To 1023 Bytes	0 (+0)	
Ethernet Rx 1024 To Max Bytes	0 (+0)	
Ethernet Tx Drops	803 (+803)	
Ethernet Tx Packets	0 (+0)	
Ethernet Tx Broadcasts	0 (+0)	
Ethernet Tx Multicasts	0 (+0)	
Ethernet Tx Collisions	0 (+0)	
Ethernet Tx 64 Bytes	0 (+0)	
Ethernet Tx 65 To 127 Bytes	0 (+0)	
Ethernet Tx 128 To 255 Bytes	0 (+0)	
Ethernet Tx 256 To 511 Bytes	0 (+0)	
Ethernet Tx 512 To 1023 Bytes	0 (+0)	
Ethernet Tx 1024 To Max Bytes	0 (+0)	
Ethernet Tx Fifo Drops	0 (+0)	
Ethernet Rx Pause Frames	0 (+0)	
Ethernet Tx Pause Frames	0 (+0)	
Ethernet Rx Classified Drops	0 (+0)	
Ethernet Rx Frames Q0	0 (+0)	
Ethernet Rx Frames Q1	822 (+822)	
Ethernet Rx Frames Q2	0 (+0)	
Ethernet Rx Frames Q3	0 (+0)	
Ethernet Rx Frames Q4	0 (+0)	
Ethernet Rx Frames Q5	0 (+0)	
Ethernet Rx Frames Q6	0 (+0)	
Ethernet Rx Frames Q7	0 (+0)	
Ethernet Tx Frames Q0	655 (+655)	
Ethernet Tx Frames Q1	0 (+0)	
Ethernet Tx Frames Q2	0 (+0)	
Ethernet Tx Frames Q3	0 (+0)	
Ethernet Tx Frames Q4	0 (+0)	
Ethernet Tx Frames Q5	0 (+0)	
Ethernet Tx Frames Q6	0 (+0)	
Ethernet Tx Frames Q7	0 (+0)	
Internal Stack		
Packets To Internal Stack	676 (+230)	
Packets From Internal Stack	898 (+366)	
Packets Ignored By Internal Stack	0 (+0)	
Detailed Counters Page Refresh Period	3600	Seconds

Wireless

Attributes	Value	Units
Wireless Rx Octets	55,012 (+55,012)	
Wireless Tx Octets	349,490 (+349,490)	
Wireless Rx Drops	0 (+0)	
Wireless Rx Packets	598 (+153)	
Wireless Rx Broadcasts	106 (+106)	
Wireless Rx Multicasts	0 (+0)	
Wireless Rx Crc And Align	0 (+0)	
Wireless Rx Undersize	0 (+0)	
Wireless Rx Oversize	0 (+0)	
Wireless Rx Fragments	0 (+0)	
Wireless Rx Jabbers	0 (+0)	
Wireless Rx 64 Bytes	524 (+524)	
Wireless Rx 65 To 127 Bytes	46 (+46)	
Wireless Rx 128 To 255 Bytes	1 (+1)	
Wireless Rx 256 To 511 Bytes	28 (+28)	
Wireless Rx 512 To 1023 Bytes	16 (+16)	
Wireless Rx 1024 To Max Bytes	0 (+0)	
Wireless Tx Drops	1 (+1)	
Wireless Tx Packets	803 (+285)	
Wireless Tx Broadcasts	0 (+0)	
Wireless Tx Multicasts	0 (+0)	
Wireless Tx Collisions	0 (+0)	
Wireless Tx 64 Bytes	254 (+254)	
Wireless Tx 65 To 127 Bytes	153 (+153)	
Wireless Tx 128 To 255 Bytes	92 (+92)	
Wireless Tx 256 To 511 Bytes	37 (+37)	
Wireless Tx 512 To 1023 Bytes	98 (+98)	
Wireless Tx 1024 To Max Bytes	194 (+194)	
Wireless Tx Fifo Drops	0 (+0)	
Wireless Rx Pause Frames	0 (+0)	
Wireless Tx Pause Frames	0 (+0)	
Wireless Rx Classified Drops	0 (+0)	
Wireless Tx Frames Q0	0 (+0)	
Wireless Tx Frames Q1	822 (+822)	
Wireless Tx Frames Q2	0 (+0)	
Wireless Tx Frames Q3	0 (+0)	
Wireless Tx Frames Q4	0 (+0)	
Wireless Tx Frames Q5	0 (+0)	
Wireless Tx Frames Q6	0 (+0)	
Wireless Tx Frames Q7	0 (+0)	
Wireless Rx Frames Q0	655 (+655)	
Wireless Rx Frames Q1	0 (+0)	
Wireless Rx Frames Q2	0 (+0)	
Wireless Rx Frames Q3	0 (+0)	
Wireless Rx Frames Q4	0 (+0)	
Wireless Rx Frames Q5	0 (+0)	
Wireless Rx Frames Q6	0 (+0)	
Wireless Rx Frames Q7	0 (+0)	

Update Page Refresh Period | Reset System Counters

Table 145 Detailed Counters attributes

Attribute	Meaning
Tx & Rx Octets	Total number of octets (bytes) transmitted or received over the interface.
Rx Drops	Total number of frames dropped due to the lack of sufficient capacity in the receive buffer.
Rx Packets	Total number of packets received by the interface. This includes both good and bad packets.
Rx Broadcasts	Total number of good broadcast packets.
Rx Multicasts	Total number of good multicast packets.
Rx CRC and Align	Total number of packets with CRC or frame alignment errors.
Rx Undersize	Total number of packets received that are less than 64 bytes and have a valid CRC.
Rx Oversize	Total number of packets received that are greater than the maximum number of bytes with a valid CRC.
Rx Fragments	Total number of packets that are less than 64 bytes with an invalid CRC (these packet types are also known as runts).
Rx Jabbers	Total number of packets received that are greater than the maximum number of bytes with an invalid CRC.
Rx 64 Bytes	Total number 64 byte frames received.
Rx 65 to 127 Bytes	Total number of frames received in the size range 65 to 127 bytes.
Rx 128 to 255 Bytes	Total number of frames received in the size range 128 to 255 bytes.
Rx 256 to 511 Bytes	Total number of frames received in the size range 256 to 511 bytes.
Rx 512 to 1023 Bytes	Total number of frames received in the size range 512 to 1023 bytes.
Rx 1024 to Max	Total number of frames received in the size range 1024 to Maximum bytes.
Tx Drops	Total number of frames dropped due excessive collisions, late collision and frame ageing.
Tx Packets	Total number of packets received by the interface. This includes both good and bad packets.
Tx Broadcasts	Total number of good broadcast packets.

Attribute	Meaning
Tx Multicasts	Total number of good multicast packets.
Tx Collisions	Total number frames experiencing collisions.
Tx 64 Bytes	Total number 64 byte frames transmitted.
Tx 65 to 127 Bytes	Total number frames transmitted in the size range 65 to 127 bytes.
Tx 128 to 255 Bytes	Total number frames transmitted in the size range 128 to 255 bytes.
Tx 256 to 511 Bytes	Total number frames transmitted in the size range 256 to 511 bytes.
Tx 512 to 1023 Bytes	Total number frames transmitted in the size range 512 to 1023 bytes.
Tx 1024 to Max	Total number frames transmitted in the size range 1024 to Maximum bytes.
Tx FIFO Drops	Total number frames dropped due to lack of capacity in the transmit buffer, for example when the PTP 600 Series is connected to the local Ethernet at a connection speed of less than 1 Gbps.
Rx & Tx Frames Q0…Q7	Total number of received or transmitted frames for each Traffic Class (Q0 to Q7).
Rx & Tx Pause Frames	Total number of received or transmitted pause frames (Ethernet interface only).
Packets To Internal Stack	The total number of good packets the bridge has transmitted to the internal stack.
Packets From Internal Stack	The total number of good packets the bridge has received from the internal stack.
Packets Ignored By Internal Stack	The total number of bad packets the bridge has transmitted to the internal stack.
Rx Classifier Drops	Total number of received frames dropped due to the application of classifier rules.
Detailed Counters Page Refresh Period	The statistics page refreshes automatically according to the setting entered here (in seconds).

Using the diagnostics plotter

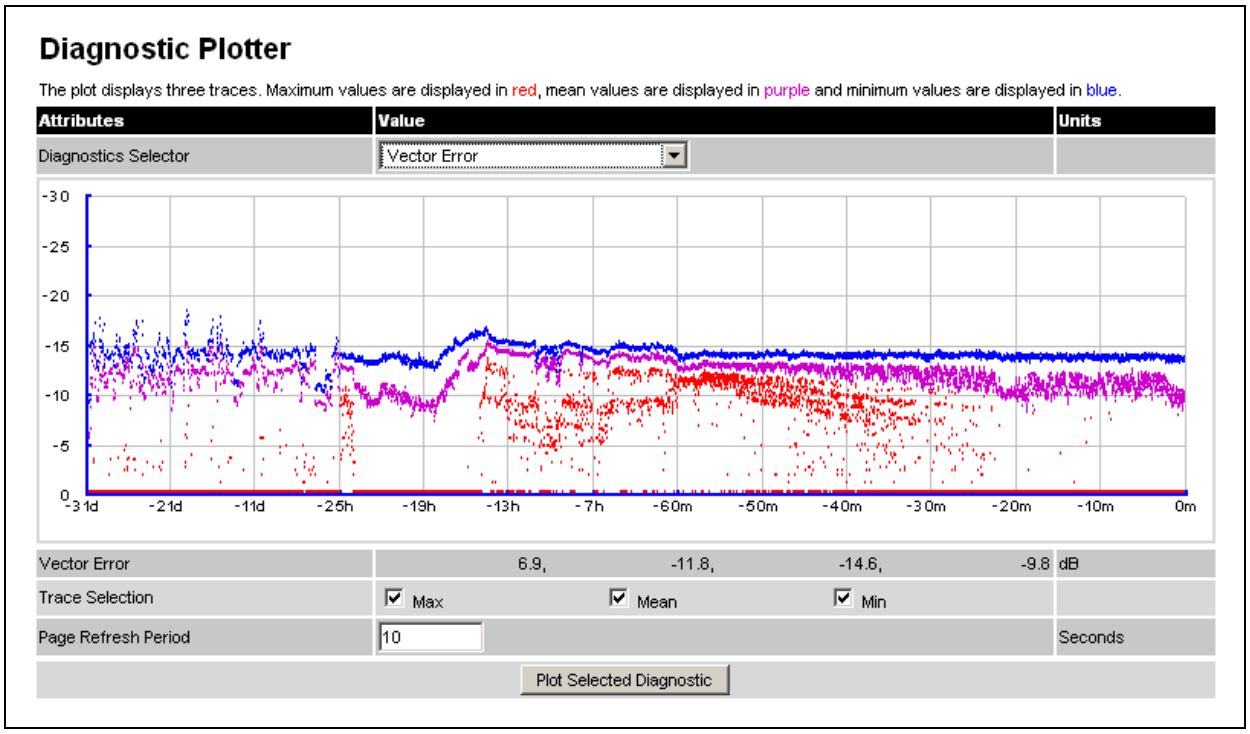
To plot diagnostics, select menu option **System, Diagnostics Plotter**. The Diagnostics Plotter page is displayed (Figure 178).

Use the Diagnostics Selector drop-down list to select a diagnostic type to plot (refer to Table 140 for definitions).

Use the Trace Selection to select traces of the maximum, mean or minimum values of the diagnostic type. Maximum values are displayed in red, mean values are displayed in purple and minimum values are displayed in blue.

Select **Plot Selected Diagnostic**. The trace is displayed in the graph.

Figure 178 Diagnostic Plotter page



Changing the diagnostics refresh period

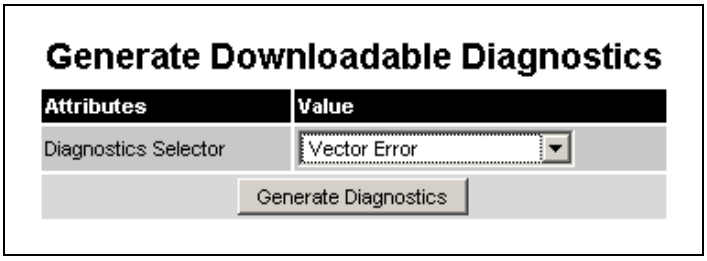
The default refresh period is 3600 seconds (1 hour). If a much shorter refresh period is selected, for example 60 seconds, it is possible to monitor the performance of an operational PTP 600 link in real time.

To change the diagnostics refresh period, select menu option **System, Diagnostics Plotter**. The Diagnostics Plotter page is displayed (Figure 178). Enter the required refresh frequency in the Page Refresh Period attribute.

Downloading diagnostic data

To download diagnostics data, proceed as follows:

1. Select menu option **System, Diagnostics Plotter, CSV Download**. The Generate Downloadable Diagnostics page is displayed:



2. Use the drop-down list to select a diagnostic type to download.
3. Select **Generate Diagnostics**. The Generate Downloadable Diagnostics page is redisplayed with the name of the generated CSV file.
4. Click on the CSV file name and select Save File. Save the CSV file to the hard drive of the local computer.
5. Open the CSV file in MS Excel and use it to generate reports and diagrams. The CSV file contains at most 5784 entries, recorded over a 32 day period:

   3600 entries recorded in the last hour.

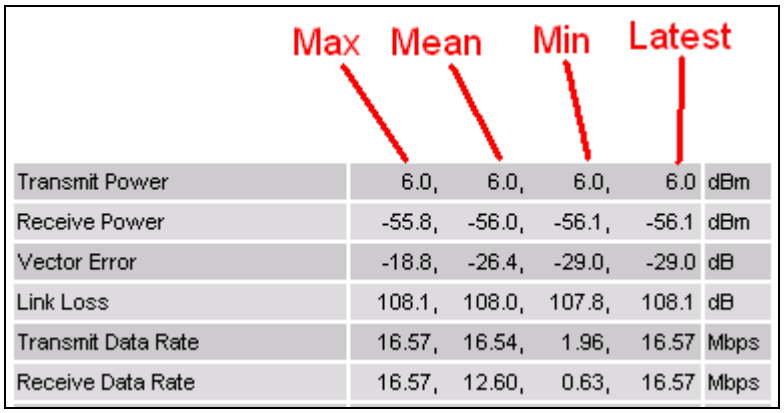
   1440 entries recorded in the previous 24 hours.

   744 entries recorded in the previous 31 days.

Diagnostics calculated over time

The System Status page (Figure 162) contains six diagnostic attributes that are calculated over time and presented as arrays of four elements (Figure 179). These attributes are defined in Table 132.

Figure 179 Diagnostic attributes calculated over time (System Status page)


Max
Mean
Min
Latest
Transmit Power 6.0, 6.0, 6.0, 6.0 dBm
Receive Power -55.8, -56.0, -56.1, -56.1 dBm
Vector Error -18.8, -26.4, -29.0, -29.0 dB
Link Loss 108.1, 108.0, 107.8, 108.1 dB
Transmit Data Rate 16.57, 16.54, 1.96, 16.57 Mbps
Receive Data Rate 16.57, 12.60, 0.63, 16.57 Mbps

The System Statistics page (Figure 176) contains eight diagnostic attributes; the above six plus Signal Strength Ratio and Aggregate Data Rate. These attributes are defined in Table 140.

The element arrays represent the following:

- Max: The maximum value measured over the last hour.
- Mean: The mean of a set of values recorded at one second intervals over the last hour.
- Min: The minimum value measured the last hour.
- Latest: The latest value measured.

If the link has been running for less than one hour, then the values are calculated over the time that has elapsed since the link was established.

These attributes can be plotted against time, downloaded and reset by using the Diagnostics Plotter page, as described in Using the diagnostics plotter on page 7-45.

Restoring, upgrading and rebooting

This section describes how to restore the system configuration, upgrade the software and reboot the unit.

This section contains the following procedures:

- Restoring the system configuration on page 7-48
- Upgrading software on page 7-49
- Rebooting or reviewing reboot reasons on page 7-52

Restoring the system configuration

Perform this procedure to restore a PTP 600 unit to a previously saved configuration. Refer to Task 17: Saving the system configuration on page 6-110 for instructions on when and how to save the configuration.

> **NOTE**
> The restore is only guaranteed to work if the installed software version has not been changed since the configuration file was saved. This is why the configuration should always be saved immediately after upgrading the software version.

Licensed capabilities

The license key is restored automatically if the configuration file is saved and then loaded on the same unit. However, the license key is not restored if the configuration file is loaded on a different unit. Before restoring configuration to a different PTP 600 unit, ensure that a valid license key is installed (with optional capabilities enabled where appropriate). For instructions, see Task 3: Installing license keys on page 6-14.

Restoring from the configuration file

To restore the system configuration from file, select menu option **Configuration**, **Save And Restore**. The Save & Restore Configuration page is displayed (Figure 158). Select **Browse** and navigate to the PC folder containing the saved configuration file (.cfg). Select **Restore Configuration File and Reboot**. Select **OK** to confirm the restore. The configuration file is uploaded and used to reconfigure the new unit to the same state as the old unit. On completion, the unit reboots.

Attributes excluded from save and restore

Most of the configuration can be restored from the backup. However, certain attributes that were part of the configuration are not saved or restored automatically. Use the web interface to reconfigure the following attributes:

- Usernames, passwords and roles for the web-based interface.
- Key of Keys
- HTTPS Entropy
- HTTPS Private Key
- HTTPS Public Key Certificate
- HTTP Access Enabled
- HTTPS Access Enabled
- Telnet Access Enabled
- HTTP Port Number
- HTTPS Port Number
- Telnet Port Number
- Encryption Algorithm
- Encryption Key
- SNMP Control Of HTTP And Telnet

Upgrading software

For instructions on how to check the installed software version and upgrade to a new version, see Task 4: Upgrading software version on page 6-17.

Alternatively, to upgrade software remotely using Trivial FTP (TFTP) triggered by SNMP, follow this procedure:

1. Check that the TFTP client is enabled. Refer to Configuring web-based management attributes on page 6-83.
2. Set tFTP attributes as described in Table 146.
3. Monitor tFTP attributes as described in Table 147.
4. When the upgrade is complete, reboot the ODU to run the newly loaded software image as described in Rebooting the unit on page 7-58.

Table 146 Setting tFTP attributes

Attribute	Meaning
tFTPServerIPAddress	The IP address of the TFTP server from which the TFTP software upgrade file Name will be retrieved. For example, to set the TFTP server IP address for unit 10.10.10.10 to 10.10.10.1, enter this command: snmpset_d.exe -v 2c -c public 10.10.10.10 .iso.3.6.1.4.1.17713.1.9.5.0 a 10.10.10.1
tFTPServerPortNumber	This setting is optional. The port number of the TFTP server from which the TFTP software upgrade file name will be retrieved (default=69).
tFTPSoftwareUpgrade FileName	The filename of the software upgrade to be loaded from the TFTP server. For example, to set the TFTP software upgrade filename on 10.10.10.10 to "B1095.dld", enter this command: snmpset_d.exe -v 2c -c public 10.10.10.10 .iso.3.6.1.4.1.17713.1.9.7.0 s B1095.dld
tFTPStartSoftware Upgrade	Write '1' to this attribute to start the TFTP software upgrade process. The attribute will be reset to 0 when the upgrade process has finished. For example, enter this command: snmpset_d.exe -v 2c -c public 10.10.10.10 .iso.3.6.1.4.1.17713.1.9.8.0 i 1

Table 147 Monitoring tFTP attributes

Attribute	Meaning
tFTPSoftwareUpgradeStatus	This is the current status of the TFTP software upgrade process. Values: idle(0) uploadinprogress(1) uploadsuccessfulprogrammingFLASH(2) upgradesuccessfulreboottorunthenewsoftwareimage(3) upgradefailed(4). For example, enter this command: snmpget_d.exe -v 2c -c public 10.10.10.10 .iso.3.6.1.4.1.17713.1.9.9.0
tFTPSoftwareUpgradeStatusText	This describes the status of the TFTP software upgrade process, including any error details. For example, enter this command: snmpget_d.exe -v 2c -c public 10.10.10.10 .iso.3.6.1.4.1.17713.1.9.10.0
tFTPSoftwareUpgradeStatusAdditionalText	This is used if tFTPSoftwareUpgradeStatusText is full and there are more than 255 characters to report. It contains additional text describing the status of the TFTP software upgrade process, including any error details. For example, enter this command: snmpget_d.exe -v 2c -c public 10.10.10.10 .iso.3.6.1.4.1.17713.1.9.11.0

Rebooting or reviewing reboot reasons

To reboot the ODU or view a list of previous reboot reasons, select menu option **System, Reboot**. The Reboot Wireless Unit page is displayed (Figure 180). Use the drop-down list to view the Previous Reasons For Reset/Reboot. If a reboot is required, select **Reboot Wireless Unit**. The Reboot Confirmation dialog is displayed (Figure 181). Select **OK**. The reboot progress message is displayed. On completion, the unit restarts.

Figure 180 Reboot Wireless Unit page

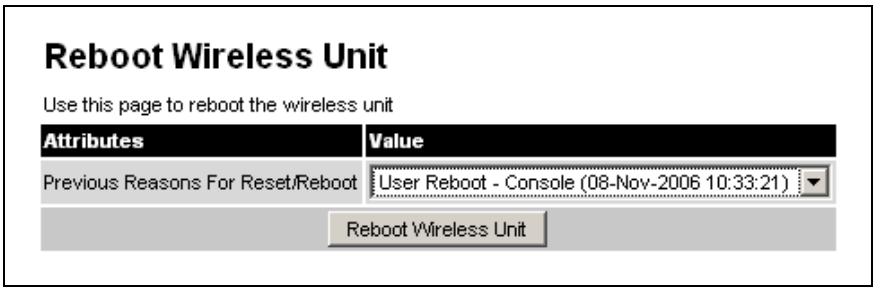
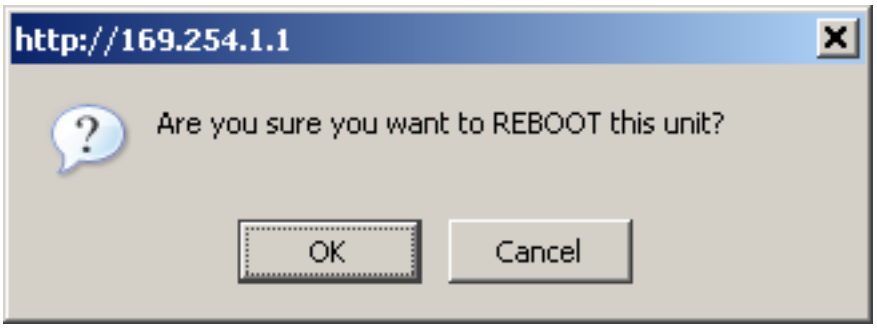


Figure 181 Reboot confirmation pop up



Using recovery mode

The Cambium PTP 600 point-to-point wireless Ethernet bridges have a special mode of operation that allows the user to recover a unit from configuration errors or software image corruption. This section describes how to enter recovery mode and how to recover the unit.

The following topics are described in this section:

- Entering recovery mode on page 7-53
- Selecting a recovery option on page 7-54
- Upgrading software image on page 7-56
- Resetting IP & Ethernet configuration on page 7-57
- Erasing configuration on page 7-58
- Rebooting the unit on page 7-58

Entering recovery mode

The unit may enter recovery mode automatically, in response to some failures.

To enter recovery mode manually, press the Recovery switch located on the underside of the PIDU while applying mains power (Figure 182), hold the Recovery switch in for between 10 and 20 seconds, then release it. The Ethernet LED will double-flash 10 times at power up.

Figure 182 PIDU recovery switch location

Selecting a recovery option

To select a recovery option when the unit is in recovery mode, access the web interface by entering the default IP address 169.254.1.1. The Recovery Image Warning page is displayed (Figure 183). Click on the warning page image. The Recovery Option Page is displayed (Figure 184). Review the Software Version and Recovery Reason (Table 148). Select a recovery option (Table 149).

Figure 183 Recovery Image Warning page

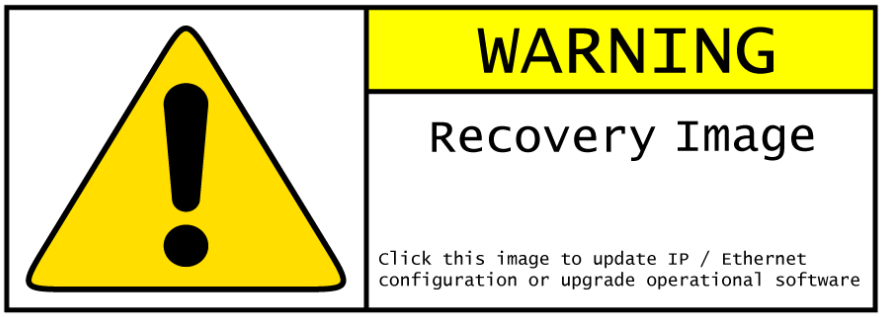


Figure 184 Recovery Options page

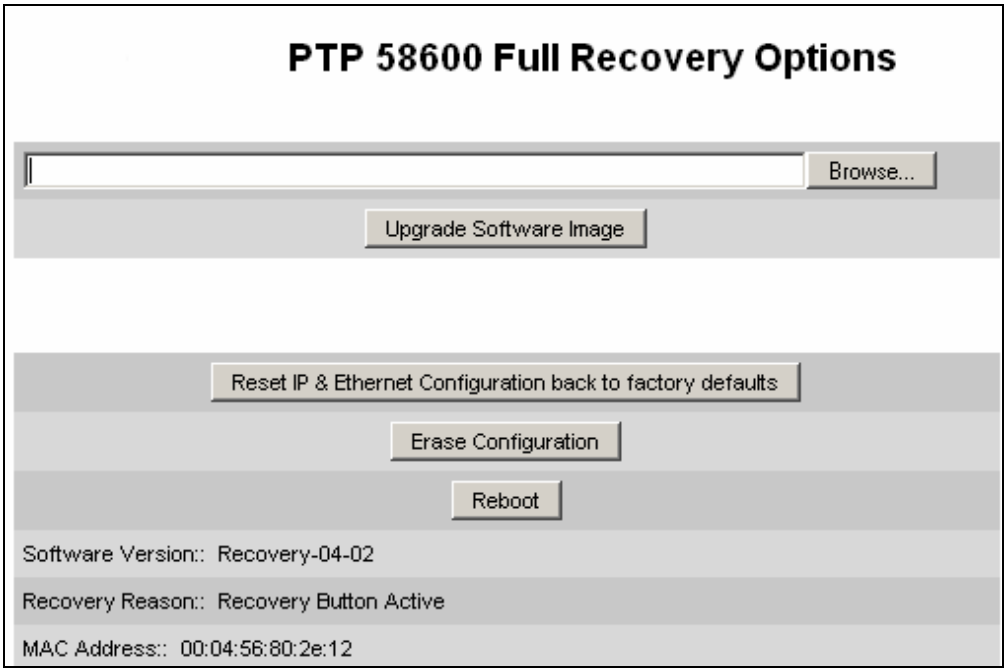


Table 148 Recovery Options attributes

Attribute	Meaning
Software Version	The software version of the recovery operating system permanently installed during manufacture.
Recovery Reason	The reason the unit is operating in Recovery mode, for example 'Recovery button active' or 'Invalid or corrupt image'.
MAC Address	The MAC address shown here is the MAC address of the unit programmed during manufacture.

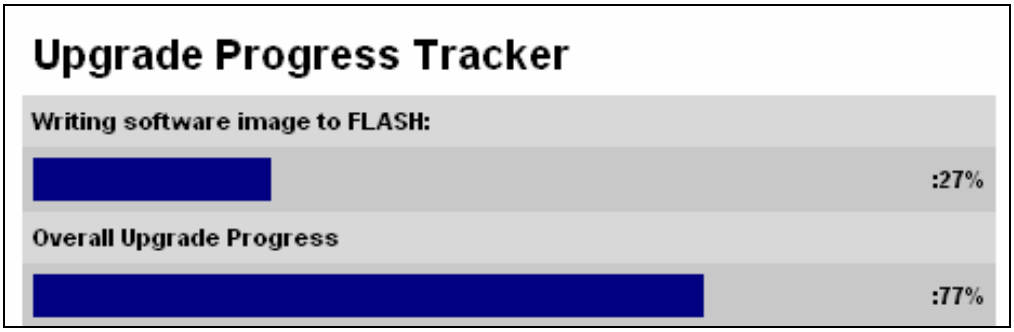
Table 149 Recovery Options buttons

Button	Purpose
Upgrade Software Image	Use this option to restore a working software version when software corruption is suspected, or when an incorrect software image has been loaded. Refer to Upgrading software image on page 7-56.
Reset IP & Ethernet Configuration back to factory defaults	Use this option to restore the IP and Ethernet attributes to their defaults. Refer to Resetting IP & Ethernet configuration on page 7-57.
Erase Configuration	Use this option to erase the entire configuration of the unit. This will also erase factory settings such as target MAC address, range setting and license key. Refer to Erasing configuration on page 7-58.
Zeroise Critical Security Parameters	Use this option to reset encryption keys and the system administrator password. Refer to Zeroizing critical security parameters on page 7-34.
Reboot	Use this option to reboot the unit. Refer to Rebooting the unit on page 7-58.

Upgrading software image

To restore a working software image from the Recovery Options page (Figure 184), proceed as follows:

1. Select **Browse**.
2. Navigate to the required software image. This may be the most recent image if software corruption is suspected, or an older image if an incorrect image has just been loaded. Click on the image and select **OK**.
3. Select **Upgrade Software Image**. The Upgrade Progress Tracker page is displayed:



4. When the Software Upgrade Complete page is displayed, check that the correct image has been downloaded:

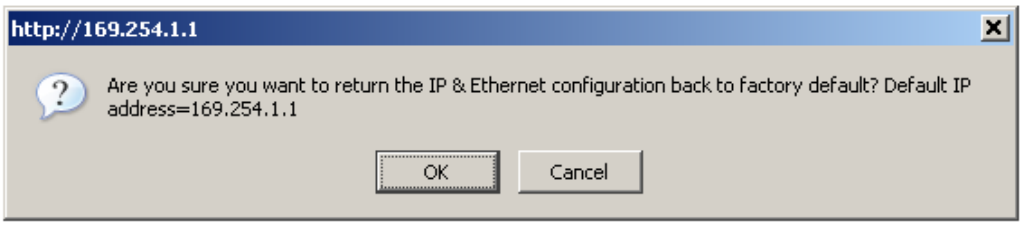
Software Upgrade Complete
The software upgrade was completed Successfully. To complete the upgrade a system reboot is required. Please use the 'Reboot Wireless Unit' button below to reboot the unit.
Current software image description
Software Version: 58600-04-01
Reboot Wireless Unit

5. Select **Reboot Wireless Unit**. When the ‘Are you sure?’ pop up box is displayed, select **OK**.
6. The unit will now reboot. The unit should restart in normal operational mode and the link should recover. If the unit or link fails to recover, refer to Testing link end hardware on page 8-2.

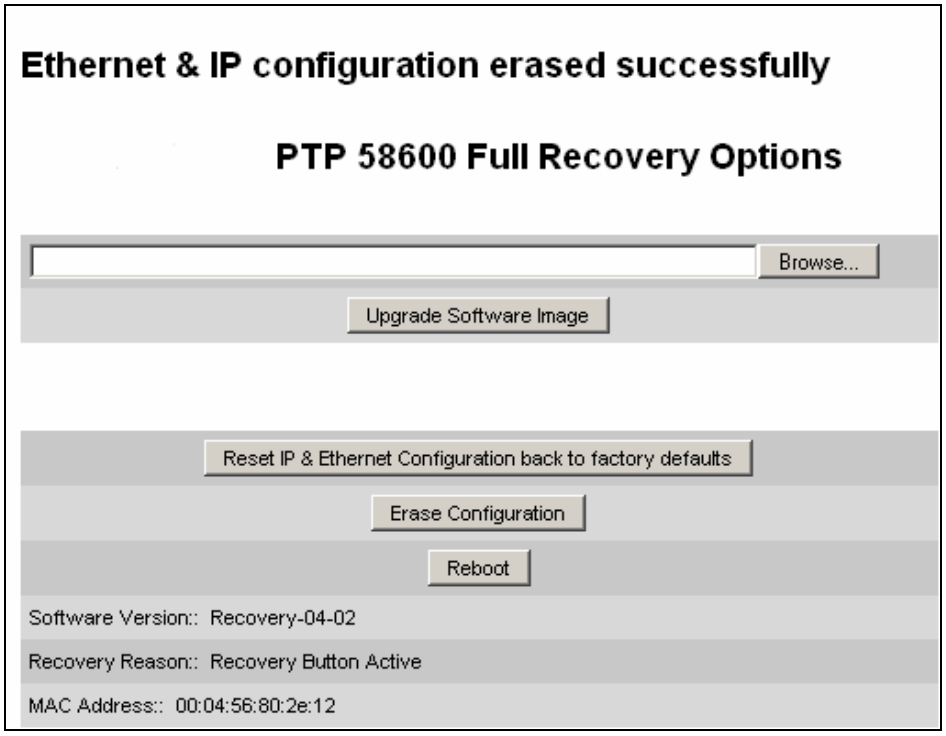
Resetting IP & Ethernet configuration

To reset IP and Ethernet configuration back to factory defaults from the Recovery Options page (Figure 184) , proceed as follows:

1. Select **Reset IP & Ethernet Configuration back to factory defaults**. The reset pop up box is displayed:


http://169.254.1.1
Are you sure you want to return the IP & Ethernet configuration back to factory default? Default IP address=169.254.1.1
OK
Cancel

2. Record the IP address, as it will be needed to log into the unit after recovery.
3. Select **OK**. The reset confirmation page is displayed:

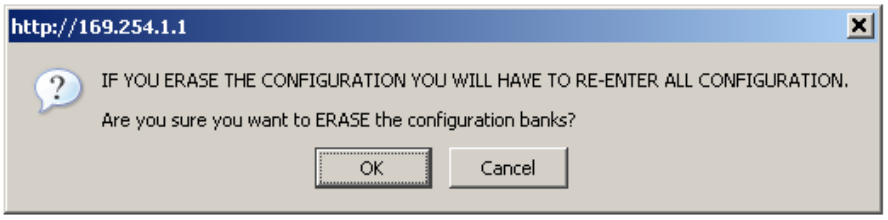


4. Select **Reboot**. When the 'Are you sure?' pop up box is displayed, select **OK**.
5. The unit will now reboot. The unit should now start up in normal mode but with the IP and Ethernet configuration reset to factory defaults. If the unit fails to recover, refer to Testing link end hardware on page 8-2.

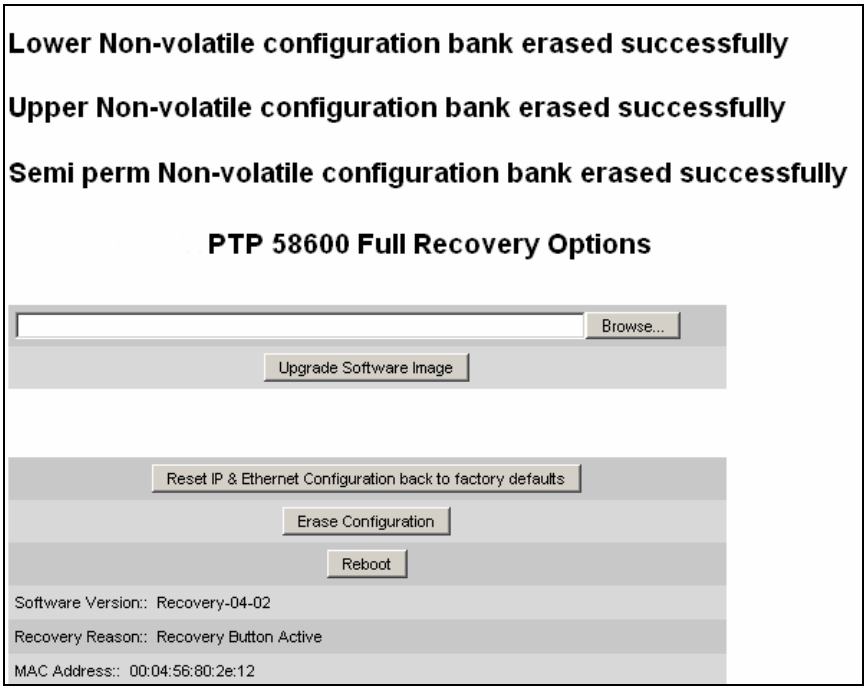
Erasing configuration

To erase the entire configuration of the unit from the Recovery Options page (Figure 184), proceed as follows:

1. Select **Erase Configuration**. The erase pop up box is displayed:


http://169.254.1.1
IF YOU ERASE THE CONFIGURATION YOU WILL HAVE TO RE-ENTER ALL CONFIGURATION.
Are you sure you want to ERASE the configuration banks?
OK
Cancel

2. Select **OK**. The erase confirmation page is displayed:


Lower Non-volatile configuration bank erased successfully
Upper Non-volatile configuration bank erased successfully
Semi perm Non-volatile configuration bank erased successfully
PTP 58600 Full Recovery Options
Browse...
Upgrade Software Image
Reset IP & Ethernet Configuration back to factory defaults
Erase Configuration
Reboot
Software Version:: Recovery-04-02
Recovery Reason:: Recovery Button Active
MAC Address:: 00:04:56:80:2e:12

3. Select **Reboot**. When the 'Are you sure?' pop up box is displayed, select **OK**.
4. The unit will now reboot. The unit should now start up in normal mode but with all configuration erased.
5. If the unit fails to start up, refer to Testing link end hardware on page 8-2.

Rebooting the unit

To reboot the unit from the Recovery Options page (Figure 184), select **Reboot**. When the 'Are you sure?' pop up box is displayed, select **OK**. The unit will now reboot. The unit should now start up in normal operational mode. If the unit fails to start up, refer to Testing link end hardware on page 8-2.

Chapter 8: Troubleshooting

This chapter contains procedures for identifying and correcting faults in a PTP 600 link. These procedures can be performed either on a newly installed link, or on an operational link if communication is lost, or after a lightning strike.

The following topics are described in this chapter:

- Testing link end hardware on page 8-2 describes how to test the link end hardware, either when it fails on startup, or after a lightning strike.
- Testing the radio link on page 8-11 describes how to test the link when there is no radio communication, or when it is unreliable, or when the data throughput rate is too low.
- Testing PTP-SYNC on page 8-13 describes how to test the PTP-SYNC unit and its connections when the PTP-SYNC LEDs do not illuminate correctly, or when a synchronization fault is suspected.
- Testing a telecoms link on page 8-16 describes how to perform a loopback test on an E1 or T1 link.
- Troubleshooting a fiber interface on page 8-18. Describes how to respond to any problems experienced when a fiber link is installed.

Testing link end hardware

This section describes how to test the link end hardware when it fails on startup or during operation.

Before testing link end hardware, confirm that all outdoor drop cables, that is those that connect the ODU or GPS receiver (if installed) to equipment inside the building, are of the supported type, as defined in Ordering components on page 2-53.

If an UltraSync GPS synchronization unit has been installed, but one or more of its status LEDs are not illuminated, refer to Test UltraSync GPS receiver on page 8-10.

Checking the PIDU LEDs

When the PIDU is connected to the power supply, the expected LED sequence is:

a. The Power (green) LED illuminates steadily.

b. After about 45 seconds, the Ethernet (yellow) LED blinks slowly 10 times.

c. The Ethernet (yellow) LED illuminates steadily, then blinks randomly to show Ethernet activity.

If the expected LED sequence does not occur, or if a fault is suspected in the link end hardware, check the PIDU LED states and choose the correct test procedure:

- Power LED is off on page 8-3
- Power LED is blinking on page 8-3
- Ethernet LED did not blink 10 times on page 8-3
- Ethernet LED is off on page 8-4
- Ethernet LED blinks irregularly on page 8-5 (for example there is a short blink followed by a long blink)
- Power LED is on, Ethernet LED blinks randomly on page 8-5

If a fault is suspected in the ODU-PIDU drop cable, perform Test resistance in the ODU cable on page 8-8.

Power LED is off

Meaning: Either the PIDU is not receiving power from the AC/DC outlet, or there is a wiring fault in the ODU cable.

Action: Remove the ODU cable from the PIDU and observe the effect on the Power LED:

- If the Power LED does not illuminate, confirm that the mains power supply is working, for example, check the plug and fuse (if fitted). If the power supply is working, report a suspected PIDU fault to Cambium.
- If the Power LED does illuminate, perform Test resistance in the ODU cable on page 8-8.

Power LED is blinking

Meaning: There is a short circuit in the ODU cable.

Action: Remove the ODU cable from the PIDU. Check that pins 4&5 and 7&8 are not crossed with pins 1&2 and 3&6. Check that the resistance between pins 1&8 is greater than 100K ohms. If either check fails, replace or repair the ODU cable.

Ethernet LED did not blink 10 times

Meaning: There is an overloaded or short circuit in the power supply to the LPU and ODU.

Action:

1. Remove the ODU cable from the PIDU. Examine it for signs of damage. Check that the ODU cable resistances are correct, as specified in Test resistance in the ODU cable on page 8-8. If the ODU cable is suspect, replace it.
2. Remove the LAN cable from the PIDU. Examine it for signs of damage. If the LAN cable is suspect, replace it.

3 Use the LPU (if installed) to check that power is available on the cable to the ODU. Access the connections by rotating the LPU lid as shown:

Slacken the lid nut but do not remove it.

4 Test that test point P1 on the LPU PCB corresponds to pin 1 on the RJ45. Repeat for points P2 to P8.

> **NOTE**
> This test is only valid if both the PIDU and the ODU are disconnected.

5 Reconnect the ODU cable to the PIDU.

6 Check that the PWR LED near the top right of the LPU PCB is illuminated to indicate power in the Ethernet cable.

7 If any test fails, replace or repair the cable that connects the PIDU to the LPU or ODU.

Ethernet LED is off

Meaning: There is no Ethernet traffic between the PIDU and ODU.

Action: The fault may be in the LAN or ODU cable:

- Remove the LAN cable from the PIDU, examine it and confirm it is not faulty.
- If the PC connection is working, remove the ODU cable from the PIDU, examine it, and check that the wiring to pins 1&2 and 3&6 is correct and not crossed.

Ethernet LED blinks irregularly

Meaning: If the Ethernet LED blinks irregularly, for example there is a short blink followed by a long blink, this indicates that the ODU has booted in recovery mode. The causes may be installation wiring or a corrupt ODU software load

Action: Refer to Using recovery mode on page 7-53.

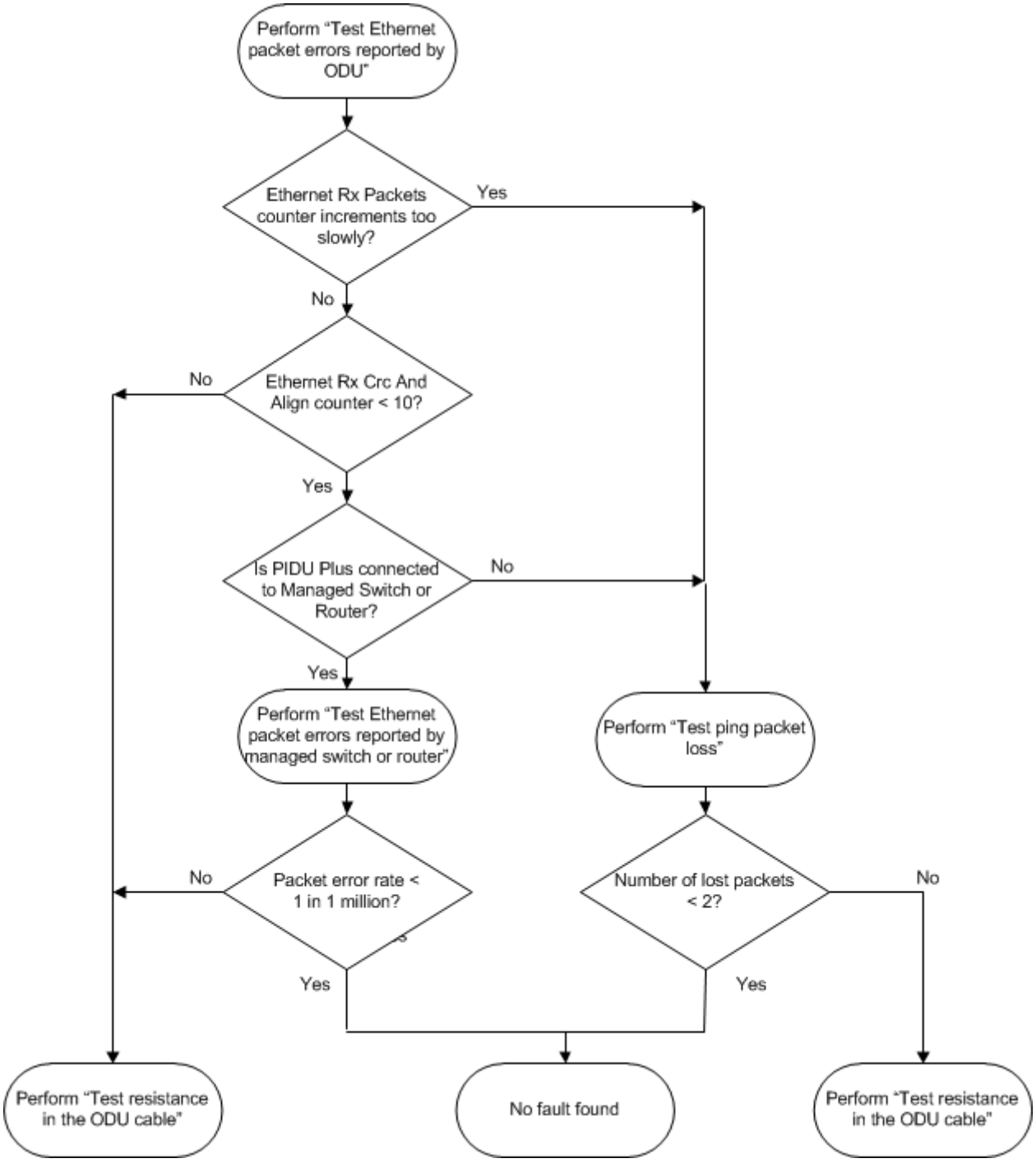
Power LED is on, Ethernet LED blinks randomly

Meaning: Both LEDs are in their 'normal' states, implying that the PIDU is receiving power from the AC/DC outlet and there is normal Ethernet traffic between the PIDU and ODU.

Action: If, in spite of this, a fault is suspected in the link end hardware:

- If the Ethernet connection to the network is only 10/100 BaseT, when 1000 BaseT is expected: remove the ODU cable from the PIDU, examine it, and check that the wiring to pins 4&5 and 7&8 is correct and not crossed.
- Follow the Ethernet packet test flowchart (Figure 185) and procedures below.

Figure 185 Ethernet packet test flowchart


Perform "Test Ethernet packet errors reported by ODU"
Ethernet Rx Packets counter increments too slowly?
Yes
No
Ethernet Rx Crc And Align counter < 10?
No
Yes
Is PIDU Plus connected to Managed Switch or Router?
No
Yes
Perform "Test Ethernet packet errors reported by managed switch or router"
Perform "Test ping packet loss"
Packet error rate < 1 in 1 million?
No
Number of lost packets < 2?
No
Yes
Yes
Perform "Test resistance in the ODU cable"
No fault found
Perform "Test resistance in the ODU cable"

Test Ethernet packet errors reported by ODU

Log into the unit and select **Administration**, **Statistics**, **Detailed Counters**. Select **Reset System Counters** at the bottom of the page and wait until the Ethernet Rx Packets counter has reached 1 million (the count will only update when the page is refreshed. If the counter does not increment or increments too slowly, because for example the PTP 600 is newly installed and there is no offered Ethernet traffic, then abandon this procedure and consider using the procedure Test ping packet loss on page 8-7.

Check the Ethernet Rx Crc And Align counter. The test has passed if this is less than 10.

Test Ethernet packet errors reported by managed switch or router

If the ODU is connected to a managed Ethernet switch or router, it may be possible to monitor the error rate of Ethernet packets. Please refer to the user guide of the managed network equipment. The test has passed if the rate of packet errors reported by the managed Ethernet switch or router is less than 10 in 1 million packets.

Test ping packet loss

Using a computer, it is possible to generate and monitor packets lost between the PIDU and the ODU. This can be achieved by executing the Command Prompt application which is supplied as standard with Windows and MAC operating systems.

To test ping packet loss, proceed as follows:

1. Ensure that the IP address of the computer is configured appropriately for connection to the PTP 600 under test, and does not clash with other devices connected to the network.
2. If the PIDU is connected to an Ethernet switch or router then connect the computer to a spare port, if available.
3. If it is not possible to connect the computer to a spare port of an Ethernet switch or router, then the PIDU will need to be disconnected from the network in order to execute this test:
    a. Disconnect the PIDU from the network.
    b. Connect the computer directly to the LAN port of the PIDU.

    ⚠ CAUTION
    This will disrupt network traffic carried by the PTP 600 under test:
4. On the computer, open the Command Prompt application.

5 Send 1000 ping packets of length 1500 bytes. The process will take 1000 seconds, which is approximately 17 minutes.

If the computer is running a Windows operating system, this is achieved by typing:

```
ping -n 1000 -l 1500 <ipaddress>
```

where <ipaddress> is the IP address of the PTP 600 ODU under test.

If the computer is running a MAC operating system, this is achieved by typing:

```
ping -c 1000 -s 1492 <ipaddress>
```

where <ipaddress> is the IP address of the PTP 600 ODU under test.

6 Record how many Ping packets have been lost. This is reported by Command Prompt on completion of the test.

The test has passed if the number of lost packets is less than 2.

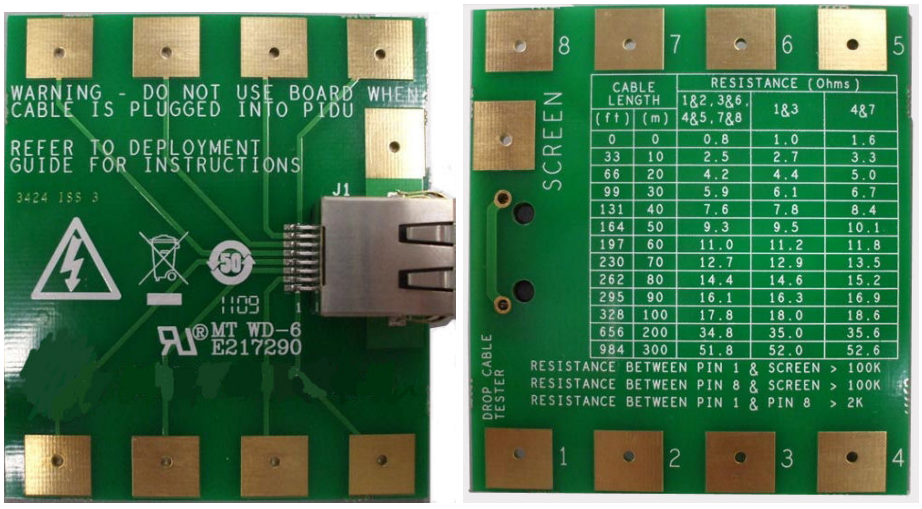
Test resistance in the ODU cable

Perform this task to test the resistances between the RJ45 pins at the PIDU end of the ODU cable.

Use the PTP drop cable tester (Figure 186) to make testing easier. This can be ordered from the support website (see Contacting Cambium Networks on page 2) by completing the order form.

> **NOTE**
> The values printed on the PTP drop cable tester are example values and should only be used for guidance.

Figure 186 Drop cable tester (front and back views)


WARNING - DO NOT USE BOARD WHEN CABLE IS PLUGGED INTO PIDU
REFER TO DEPLOYMENT GUIDE FOR INSTRUCTIONS
J1
MT WD-6
E217290
SCREEN
CABLE LENGTH
RESISTANCE (Ohms)
(ft) (m)
1&2,3&6, 4&5,7&8
1&3
4&7
0 0 0.8 1.0 1.6
33 10 2.5 2.7 3.3
66 20 4.2 4.4 5.0
99 30 5.9 6.1 6.7
131 40 7.6 7.8 8.4
164 50 9.3 9.5 10.1
197 60 11.0 11.2 11.8
230 70 12.7 12.9 13.5
262 80 14.4 14.6 15.2
295 90 16.1 16.3 16.9
328 100 17.8 18.0 18.6
656 200 34.8 35.0 35.6
984 300 51.8 52.0 52.6
RESISTANCE BETWEEN PIN 1 & SCREEN > 100K
RESISTANCE BETWEEN PIN 8 & SCREEN > 100K
RESISTANCE BETWEEN PIN 1 & PIN 8 > 2K
DROP CABLE TESTER
8 7 6 5
1 2 3 4

If PTP-SYNC is not installed, unplug the drop cable from the ODU port of the PIDU. If PTP-SYNC is installed, unplug the drop cable from the ODU OUT port of the PTP-SYNC unit. Connect the drop cable tester to the end of the drop cable. Then, perform the tests described in Table 150. Record the results in the Result column, if this is helpful.

Table 150 RJ45 cable resistance tests at the PIDU end

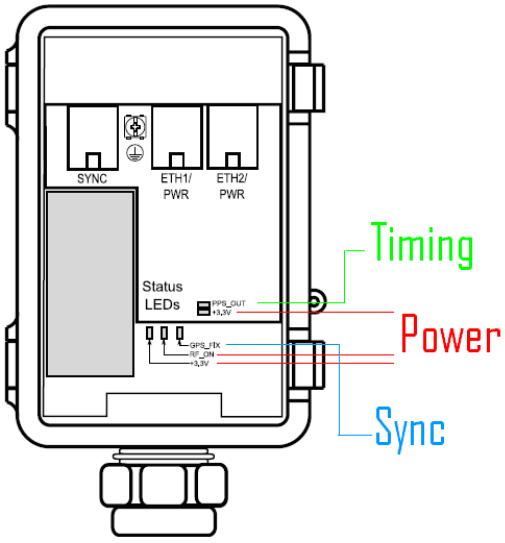
Step	Test	Result
1	Measure the resistance between pins 1 and 2.	Ohms
2	Measure the resistance between pins 3 and 6.	Ohms
3	Measure the resistance between pins 4 and 5.	Ohms
4	Measure the resistance between pins 7 and 8.	Ohms
5	Ensure that all the results of steps 1 to 4 are within 10% of each other as follows: Take the minimum result and multiply by 1.1. If any of the remaining steps 1 to 4 results are greater than this, the test has failed.	PASS or FAIL
6	Measure the resistance between pins 1 and 3. Subtract 0.2 Ohms.	Ohms
7	Measure the resistance between pins 4 and 7. Subtract 0.8 Ohms.	Ohms
8	Compare the results of steps 1 to 4 and steps 6 to 7 to the maximum allowed: If the cable is carrying Ethernet, then the maximum allowed is 20 Ohms. If the cable is carrying only power to the ODU (Ethernet over Fiber only), then the maximum allowed is 60 Ohms. If any of the steps 1 to 6 results are greater than the maximum allowed, the test has failed.	PASS or FAIL
9	Measure the resistance between pin 1 and the screen (ODU ground). If it is less than 100K ohms (regardless of cable length), the test has failed.	K Ohms PASS or FAIL
10	Measure the resistance between pin 8 and the screen (ODU ground). If it is less than 100K ohms (regardless of cable length), the test has failed.	K Ohms PASS or FAIL

Step	Test	Result
11	Measure the resistance between pin 1 and pin 8: If UltraSync GPS is not fitted, and the resistance is less than 100K Ohms (regardless of cable length), the test has failed. If UltraSync GPS is fitted, and the resistance is less than 2K Ohms (regardless of cable length), the test has failed.	K Ohms PASS or FAIL

Test UltraSync GPS receiver

The UltraSync GPS synchronization unit, if installed, is located between the ODU and the LPU. Use the status LEDs (Figure 187) to test the GPS unit.

Figure 187 GPS synchronization unit



To troubleshoot the UltraSync GPS synchronization unit, proceed as follows:

- **Power supply**: Check that the **+3.3V** and **RF_ON** LEDs are lit, indicating that the GPS is receiving power. If they are not lit, confirm that all link end hardware (PIDU, LPU, ODU and cabling) tests have been performed.
- **Synchronization**: Approximately 2 minutes after powering on, the **GPS_FIX** LED should be lit. If it is not, ensure the GPS is at a height of at least 1.8m above the ground, where there is an unobstructed path to the sky.
- **Timing**: When the GPS_FIX LED lights up, the **PPS_OUT** LED should begin blinking faintly at one pulse per second, indicating that sync is being generated. If does not, replace or repair the GPS synchronization unit.

Testing the radio link

This section describes how to test the link when there is no radio communication, when it is unreliable, when the data throughput rate is too low, or when a unit is causing radio or TV interference. It may be necessary to test the units at both ends of the link.

No activity

If there is no wireless activity, proceed as follows:

1. Check for Alarm conditions on Home page.
2. Check that the software at each end of the link is the same version.
3. Check that the Target Mac address is correctly configured at each end of the link.
4. Check Range.
5. Check Tx Power.
6. Check License keys to ensure that both units are the same product variant.
7. Check Master/Slave status for each unit and ensure that one unit is Master and the other unit is slave.
8. Check that the link is not obstructed or the ODU misaligned.
9. Check the DFS page at each end of the link and establish that there is a quiet wireless channel to use.
10. If there are no faults found in the configuration and there is absolutely no wireless signal, retry the installation procedure.
11. If this does not work then report a suspected ODU fault to Cambium.

Some activity

If there is some activity but the link is unreliable or does not achieve the data rates required, proceed as follows:

1. Check that the interference has not increased using the i-DFS measurements.
2. If a quieter channel is available check that it is not barred.
3. Check that the path loss is low enough for the communication rates required.
4. Check that the ODU has not become misaligned.

Radio and television interference

If a PTP 600 unit is interfering with radio or television reception (this can be determined by turning the equipment off and on), attempt the following corrective actions:

- Realign or relocate the antenna.
- Increase the separation between the affected equipment and antenna.
- Connect the ODU and PoE power supply into a power outlet on a circuit different from that to which the receiver is connected.
- Contact Cambium Point-to-Point for assistance.

Testing PTP-SYNC

Checking the PTP-SYNC LEDs

If a fault is suspected in the PTP-SYNC or GPS hardware, check the PTP-SYNC LED states and use Table 151 to choose the correct test procedure.

Table 151 PTP-SYNC indicator LED states

LED	State	Description and test procedure
GPS	Off	No GPS satellite data being received at the GPS/SYNC IN port. Refer to GPS LED does not illuminate or blink on clustered units on page 8-15.
	On steady or blink	GPS satellite data being received.
SYNC	Off	No data being received at the SYNC OUT port.
	On steady or blink	Data being received at the SYNC OUT port. The SYNC LED does not normally illuminate, even in cluster configurations.
STATUS	Off	No power. Refer to LEDs do not illuminate on page 8-14.
	On steady	Power but no satellite lock. Refer to STATUS LED is on steady on page 8-14.
	Blink	Power and satellite lock at either the GPS/SYNC IN or 1PPS IN port.
	Double blink (*)	Possible fault in GPS/SYNC IN or 1PPS IN cables. Refer to STATUS LED double-blinks on page 8-14.
ODU	Off	No signal being received from the ODU. Refer to ODU LED does not illuminate within 90 seconds on page 8-14.
	On	Communication with the ODU is established.
	Blink red (*)	Error in communication with ODU. Refer to ODU LED blinks red on page 8-15,

(*)These states are not available in PTP-SYNC model number WB3665AA. The model number is located underneath the unit, on the bar code label.

LEDs do not illuminate

Meaning: The PTP-SYNC unit is not powered up.

Action: Ensure that there is a cable connection between the PIDU 'ODU' interface and the 'PIDU IN' interface of the PTP-SYNC unit. Confirm that the PIDU is powered up.

STATUS LED is on steady

Meaning: There is power but no satellite lock. This probably indicates that a 1PPS synchronization pulse is not detected by the PTP-SYNC unit.

Action: Depending on system configuration, take one of the following actions:

- System using a GPS receiver module - Ensure that there is a cable connection between the PTP-SYNC 'GPS/SYNC IN' interface and the LPU, also that there is a cable connection between the LPU and the GPS receiver module. Check that the GPS receiver module has an uninterrupted view of the sky.
- System using an alternative 1PPS timing source - Ensure that there is a cable connection between the PTP-SYNC 'GPS/SYNC IN' or '1PPS IN' interface and the 1PPS timing source.
- On cluster slave units – Ensure that there is a cable connection between the slave GPS/SYNC IN interface and the SYNC OUT interface of the preceding unit in the chain.

STATUS LED double-blinks

Meaning: There may be a fault in the GPS/SYNC IN or 1PPS IN cables.

Action: Check the GPS wiring in accordance with Table 54.

> **NOTE**
> This state is not available in PTP-SYNC model number WB3665AA.

ODU LED does not illuminate within 90 seconds

Meaning: There may be no communication between PTP-SYNC and ODU.

Action: Ensure that the PTP-SYNC 'ODU OUT' interface is connected to the ODU (and LPUs if installed) via the drop cable.

ODU LED blinks red

Meaning: Error in communication with ODU. Possible causes are: fault in the ODU or PIDU cable, or maximum recommended cable lengths exceeded.

Action: Confirm that the ODU and PIDU cables are not too long: see Maximum cable lengths on page 2-7. Check the ODU cable wiring by following the procedure described in Test resistance in the ODU cable on page 8-8.

GPS LED does not illuminate or blink on clustered units

Meaning: This indicates a fault only when the timing source is a GPS receiver.

Action: Table 152 describes the action to be taken depending upon the behavior of the 'GPS' LEDs at the master and slave(s).

Table 152 Clustered PTP-SYNC units - 'GPS' LEDs Fault-finding

Cluster timing source	'GPS' LED on master	'GPS' LED on slave(s)	Diagnosis
GPS receiver providing NMEA data	Blink	Blink	OK
	Off	Any	Fault in GPS unit or GPS cable
	Blink	Off	Fault in daisy chain cable
Alternative 1PPS source, no NMEA data	Off	Off	OK
	Off	On	Fault in alternative 1PPS source
One ODU is cluster timing master	Off	Off	OK

Testing a telecoms link

If an E1 or T1 link has been installed, it may be helpful to test the link by performing a loopback test.

This task consists of the following procedure:

- Performing a telecoms loopback test on page 8-16

Performing a telecoms loopback test

The loopback test allows the telecoms data stream to be looped back at the copper or wireless interface. A typical T1 or E1 installation test might include a ‘Copper’ loopback on the local unit followed by a ‘Wireless’ loopback on the remote unit.

> **NOTE**
> The Telecoms page is only available when the Telecoms Interface has been set to either T1 or E1, as described in Task 6: Configuring wireless and telecoms interfaces on page 6-45.

To perform a loopback test, proceed as follows:

1. Select menu option **System, Configuration, Telecoms**. The Telecoms page is displayed (Figure 188).
2. Select the Telecoms Loopback option: ‘Copper’ or ‘Wireless’ for each channel to be tested (A or B) (Table 153).
3. Select **Submit Updated System Configuration**.
4. Perform loopback tests.
5. Reset Telecom Loopback to ‘None’ for operational use.

   Alarms on the Home Page indicate the presence of loopbacks on either channel.

Figure 188 Telecoms page

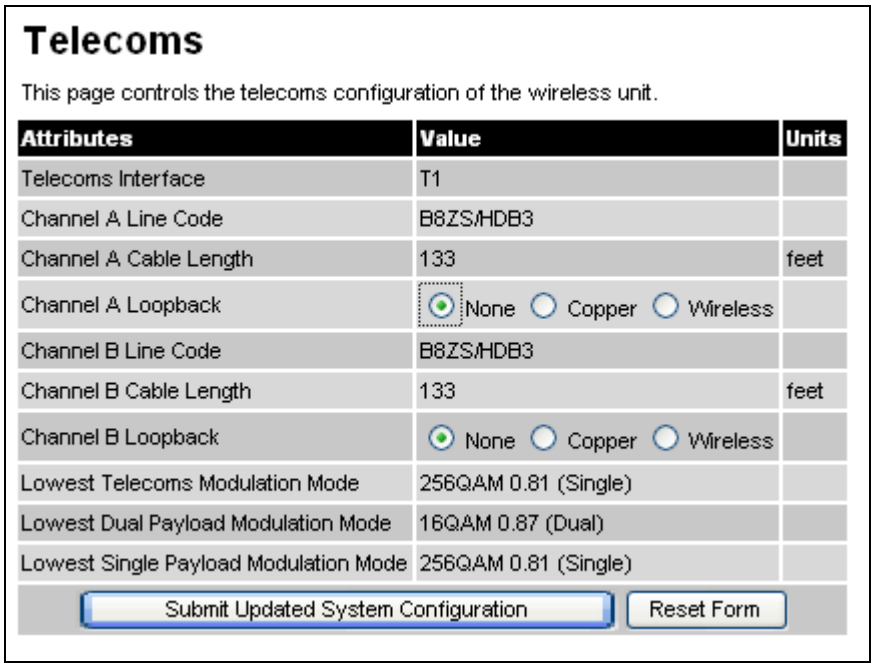


Table 153 Telecoms attributes

Value	Meaning
None	This is the required setting for an operational link.
Copper	Connects the received data on a given telecoms interface to the transmit interface. May be used, in conjunction with a Bit Error Rate Tester, to confirm that the correct connections have been made to the ODU. This mode cannot be used for resistance tests, as it is only capable of looping back valid telecoms signals.
Wireless	Sends the telecoms data received from the wireless link back across the link on the same telecoms channel. The link may be checked using, for example, a Bit Error Rate Tester to ensure that no errors are detected.

Troubleshooting a fiber interface

If any problems are experienced when a fiber link is installed, refer to this section.

No response from the unit via 1000BaseT

If the unit does not respond when connected via the 1000BaseT connection:

- Check that the Cat5e cables have been inserted correctly.
- Ensure that the network settings on your PC are correct.
- If a fiber connection has been made to your network, then remove it. In the default configuration, the wireless unit will ignore the copper connection if a fiber connection is available.
- Confirm that you have entered the IP address of the unit correctly into your browser.

No response from the unit via fiber

If the unit does not respond when connected via the fiber interface:

Browse to the unit over the wireless link (from a computer connected to the remote unit), and check whether the **SFP Configuration** menu option is available:

- If **SFP Configuration** is not available: switch off the power to the wireless unit; remove and then replace the SFP module; switch the unit back on and confirm that the SFP Configuration menu is now available.
- If **SFP Configuration** is available: check the Ethernet Link Status attribute on the System Status page to see if it indicates a fault.

Trying swapping the transmit and receive fibers

Remove and remake both ends of the fiber connection, ensuring that is no dust or other debris contaminating the connections.

License key is incorrect for optical

If the license key which you have is incorrect then contact your distributor or reseller.

Fiber alarms are raised

ALARM: An SFP is installed but has been disabled because your license key does not include Fiber support:

This alarm indicates that the license key entered into the PTP 600 unit is invalid.

ALARM: No Fiber link established but no LOS (i.e. an optical carrier is detected). Broken TX Fiber or link disabled at Fiber link partner?

This alarm indicates that a signal is being received over the fiber interface but the transmit fiber is broken or the receiver at the far end is disabled.

Glossary

Term	Definition
ARP	Address Resolution Protocol
ATPC	Automatic Transmit Power Control
BPSK	Binary Phase Shift Keying
CSP	Critical Security Parameter
DC	Direct Current
DER	Distinguished Encoding Rules
DFS	Dynamic Frequency Selection
EIRP	Equivalent Isotropic Radiated Power
ETSI	European Telecommunications Standards Institute
FAQ	Frequently Asked Question
FIPS	Federal Information Processing Standard
GPS	Global Positioning System
HTTP	Hypertext Transfer Protocol
IEEE	Institute of Electrical and Electronic Engineers
IP	Internet Protocol
ISM	Industrial Scientific and Medical
ITPE	Initial Transmit Power Estimate
LAN	Local Area Network
LOS	Line-of-Sight (clear line-of-sight, and Fresnel zone is clear)
LPU	Lightning Protection Unit
MAC	Medium Access Control Layer
MDI	Medium Dependent Interface
MDIX	Medium Dependent Interface Crossover
MIB	Management Information Base
NLOS	Non-Line-of-Sight
NMEA	National Marine Electronics Association

Term	Definition
ODU	Outdoor Unit
OFDM	Orthogonal Frequency Division Multiplex
PC	IBM Compatible Personal Computer
PIDU	Powered Indoor Unit
PTP	Point-to-Point
QAM	Quadrature Amplitude Modulation
RAM	Random Access Memory
RF	Radio Frequency
RSSI	Received Signal Strength Indication
SELV	Safety Extra Low Voltage
SMTP	Simple Mail Transport Protocol
SNMP	Simple Network Management Protocol
SNTP	Simple Network Time Protocol
STP	Shielded Twisted Pair
STP	Spanning Tree Protocol
TCP	Transmission Control Protocol
TLS	Transport Layer Security
TDWR	Terminal Doppler Weather Radar
URL	Universal Resource Location
UTC time	Coordinated Universal Time
UTP	Unshielded Twisted Pair
UV	Ultraviolet
VLAN	Virtual Local Area Network